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No.

In the Supreme Court of the United States

OCTOBER TERM, 1982

BETHLEHEM STEEL CORPORATION
AND
INSURANCE COMPANY OF NORTH AMERICA,
APPELLANTS,

v.

RHODE ISLAND TURNPIKE
AND BRIDGE AUTHORITY,
APPELLEE.

ON APPEAL FROM THE SUPREME COURT OF RHODE ISLAND.

Appendix to Jurisdictional Statement.

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I (A)

Opinion of Supreme Court of Rhode Island
Filed June 4, 1982. 446 A.2d 752

Rhode Island Turnpike & Bridge Authority	:	Supreme Court No. 81-480-Appeal.
v.	:	
Bethlehem Steel Corp. et al.	:	

Opinion.

KELLEHER, J. This litigation, which now comes before us for the third time, presently involves cross appeals from a revised judgment entered by a Superior Court trial justice after a hearing and following a second remand. On the prior occasions this controversy has been the subject of two written opinions. They are to be found in 119 R.I. 141, 379 A.2d 344 (1977), and R.I., 415 A.2d 1295 (1980), under the title *Rhode Island Turnpike & Bridge Authority v. Bethlehem Steel Corp.*

A detailed factual recitation is unnecessary except to say that this continuing dispute arises because of the catastrophic failure of paint to adhere to the steel surface of the Newport Bridge. The lack of adhesion was due to the presence of "mill scale" which Bethlehem had failed to remove from the metal notwithstanding its contractual obligation to do so.

In Newport Bridge No. 1, a remand was required because it was evident that the Authority had received some benefit from the original paint job and Bethlehem was entitled to a credit for whatever benefit was bestowed upon the Authority. 119 R.I. at 167, 379 A.2d at 358. A second remand followed Newport Bridge No. 2, where we affirmed the trial justice's determination that Bethlehem was entitled to a 25 percent credit[1] but then sustained the Authority's cross ap-

[1] Testimony at the first remand hearing established that if the steel work had been properly prepared, the original paint job should have lasted twelve years. The trial justice, in establishing the credit percentage of twenty-five, found that the paint served a useful purpose for three of the twelve expected years.

peal by holding that the 25 percent credit was to be applied solely to the actual cost of applying the paint needed to remedy Behtlehem's negligent surface preparation. No credit was to be allowed for the cost of the sandblasting that was necessary to remove the mill scale which had caused the original paint failure. The second remand also authorized the trial justice to require the presentation of additional evidence if he thought it necessary.

When the litigants appeared before the trial justice after the second remand, it was argued that an element to be considered in determining the cost of painting was the cost of sandblasting the bridge's surface as part of the normal maintenance that would have been necessitated by the usual wear and tear that would have taken place during the expected twelve-year life expectancy of the original paint job. There was also some concern expressed as to whether the testimony that had been adduced previously could form a basis for a proper allocation of the monies paid to the remedial painter, Oliver B. Cannon & Sons, Inc., to either the painting-expense category or the sandblasting-expense category. Consequently, evidence was presented as to the amount of money that would have been expended for normal maintenance sandblasting and as to how much of the remedial costs incurred by the Authority should be classified as paint or as sandblasting.

Testimony on these issues was given by Cannon's president, Robert B. Roth; Herbert M. Mandell, senior vice president of the engineering firm that had designed the bridge and supervised all phases of the construction and remedial painting; and Cannon's site superintendent, who served in this capacity at the bridge site during 1971 and was responsible for authenticating the daily reports. The superintendent's testimony was presented by way of a deposition. Valentino J. Assetto, a long-time Bethlehem employee who during his career had participated actively in the various facets of Beth-

lehem's many and varied enterprises, testified in behalf of his employer. His computations in large part were based upon the statistical data found in the 1971 daily work reports.

Roth testified regarding the allocation of costs between blasting and painting during the remedial period, which encompassed a time frame beginning in 1971 and ending in 1977, with the exception of 1974, a year during which no remedial painting was performed. Roth estimated that the normal maintenance sandblasting expenses which would have been incurred during the twelve-year life expectancy of the original paint job would have amounted to $285,576.03. His testimony, based on his experience with the Newport Bridge and others, served as a basis for the Authority's claim that 65 percent of all payments made to Cannon were attributable to remedial sandblasting. Mr. Mandell told the trial justice that 60 percent of the costs incurred by the Authority for his firm's engineering services were attributable to the remedial-sandblasting operation. Assetto's analysis of the documents presented to him resulted in a different allocation from those offered by Roth and Mandell. He estimated the normal maintenance sandblasting cost at $311,533 and placed the remedial sandblasting percentage at 27.97 percent. His calculations would have given Bethlehem a credit somewhat in excess of $1 million. In his deposition, the superintendent, besides casting doubts on the accuracy of the assumptions made by Assetto in his computations, stated that, in his opinion, the sandblasting time expended on the bridge during 1971 constituted about 75 to 80 percent of the entire remedial operation.

In analyzing the evidence, the trial justice discussed the different allocations of costs advanced by both the Authority and Bethlehem and the sources of evidence supporting those allocations. He specifically found Assetto's testimony to be unpersuasive because in his opinion it was based on records

which were neither intended nor compiled for the purpose for which Assetto used them. The trial justice concluded:

1. The cost of the remedial sandblasting was equal to 65 percent of the total net payment made to Cannon.

2. The cost of the remedial painting was equal to 35 percent of the net payment made to Cannon.

3. The normal maintenance blasting costs subject to a credit for Bethlehem were $285,576.03.

4. 60 percent of the cost for purchasing grit in 1977 was to be placed in the remedial-sandblasting category.

5. 60 percent of the fees paid to Mandell's engineering firm would be attributable to the remedial-sandblasting operation.

After making these factual conclusions, the trial justice turned to matters mathematical. The total net payment made to Cannon by the Authority was $5,059,467.43. The trial justice then applied the 35 percent remedial-paint factor to the total net amount and determined that the true painting cost amounted to $1,770,813.61. He then applied the 25 percent credit factor due Bethlehem to both the $1,770,813.61 cost of remedial painting and the $285,576.03 representing the estimated expense for the routine maintenance sandblasting. After making the necessary addition and multiplication, the trial justice arrived at a credit figure of $514,097.41. Thus, when the $514,000-plus figure was deducted from the total net paid to Cannon, the Authority's net cost was reduced to $4,545,370.02.

After the trial justice had made additional computations for such items as the grit expense and the engineering fees, the amount due the Authority from Bethlehem was adjusted upward to $4,935,023.90. From this figure must be deducted the $804,996.55 counterclaim of Bethlehem which was upheld in the court's consideration of Newport Bridge No. 1.

At this juncture we should point out that at no time do the litigants challenge the accuracy of the trial justice's

mathematics, nor does Bethlehem contest his 60 percent allocations of the engineering fees and the 1977 grit expense. The single disputed issue which is before us concerns the trial justice's allocation of 65 percent of the remedial-painting costs to the sandblasting category.

Bethlehem's appellate argument, when all is said and done, is essentially that the trial justice should have believed the testimony of its witness rather than those offered by the Authority. Such an argument is one that should be made to the factfinder rather than an appellate court. In rejecting Assetto's estimates, the trial justice noted that his analysis was based upon reports which were "simply not generated in order to determine such an allocation of costs."

Assetto's estimates as to the percentage credits to be allocated for the maintenance and remedial-painting facets of this controversy were based on his study of Cannon's daily report sheets for 1971. Each daily sheet contains the names of various employees and a column where the hours each worked on that day are recorded. On various days there can be found notations against some employees' names reading "Blast 6 hrs." or "Blast 2 hrs." Assetto assumed that the total "Blast" notations which appeared on some of the work sheets indicated the amount of sandblasting performed on that particular day, and with this assumption as a basis he completed his 1971 calculations and then projected them for each of the other years when the repainting took place.

Assetto's assumptions were dispelled when the site superintendent testified at a deposition hearing held in Baltimore, Maryland, on March 11, 1981. The superintendent, who was then retired, made it clear that the various blasting notations simply indicate that a blasting machine had broken down after operating for the enumerated number of "hrs." The superintendent also explained that the daily reports having an absence of any blasting notations indicated that "everything went smooth. The blasters worked a full day."

In rejecting Assetto's testimony, the trial justice relied upon the explanation given by the site superintendent. Bethlehem asks that we reject this reliance because it was given by way of deposition and that we are in as good a position to assess credibility in this instance as the trial justice.

Conceding that we are in as good a position as the trial justice in passing upon the superintendent's credibility, we cannot ignore the trial justice's findings. He was called upon to make a factual determination based upon the evidence then before him. Most of the evidence came from witnesses who appeared in the Superior Court. It was his job to draw the inferences from the evidence before him, including that provided by the deposition. Such factual findings will be accepted by us so long as they are reasonable, logical, and flow from established facts. The fact that a portion of the record consists of a deposition does not give us a license to second guess the trial justice. *Chase v. Blackstone Distributing Co.*, 110 R.I. 537, 545, 294 A.2d 392, 396 (1972). We have examined the superintendent's testimony and, notwithstanding Bethlehem's strenuous and ingenious arguments to the contrary, we see no reason whatsoever to disturb the factual findings made by the trial justice.

What was said as to the trial justice's factfinding ability in our consideration of Bethlehem's appeal applies with equal force to the Authority's cross appeal, in which it complains about the 25 percent credit allowed Bethlehem by the trial justice on the routine-maintenance expense of $285,576.03. Although the Authority argues to the contrary, it was never our intent in ordering the second remand that the trial justice would be foreclosed from considering such an issue as the routine maintenance cleaning credit. We specifically authorized the presentation of additional evidence, and the trial justice's maintenance credit certainly was justified in that the original paint job had adhered to the bridge work for three

years, thereby saving the Authority an estimated $71,300-plus that might have been spent for "touch-up" sandblasting.

We next address the claim by Bethlehem Steel and its surety that the interest rate of 12 percent for prejudgment interest as provided by G.L. 1956 (1969 Reenactment) § 9-21-10, as amended by P.L. 1981, ch. 54, § 1, ought not to be applied to the judgment in this case. There is no merit to Bethlehem's position.

This particular issue is hardly one of first impression in Rhode Island. This court has had several opportunities to pass on the application of § 9-21-10. The statute that was amended in 1981 to impose a prejudgment interest rate of 12 percent, in section 8 of the amending statute, provides as follows:

> "This act shall take effect upon its passage and shall be given retroactive as well as prospective effect and shall apply to all cases pending upon the effective date of this act."

Bethlehem argues that we are not required to implement the retroactive proviso of the statute. The same contention was made in *Kastal v. Hickory House, Inc.*, 95 R.I. 366, 187 A.2d 262 (1963), in which this court construed an earlier version of § 9-21-10, and cited recently in *Pray v. Narragansett Improvement Co.*, R.I. ____, 434 A.2d 923 (1981).

> "In our opinion the statute is neither ambiguous nor equivocal. It speaks imperatively and directly not to the court but to the clerk who is ordered to add 'to the amount of damages, interest thereon from the date of the writ * * *.' This is a purely ministerial act; it contemplates no judicial intervention. The legislative fiat is explicit and admits of no conditions or reservations. The claim for damages having been duly reduced to judgment the addition of interest is peremptory." *Kastal v. Hickory House, Inc.*, 95 R.I. at 369, 187 A.2d at 264.

The Legislature has amended the statute since *Kastal* on several occasions. The statute is, however, no less clear now than it was when this court decided *Kastal, supra*.

> "In the face of a statute so clear and unambiguous there is no room for the application of the usual canons of statutory construction. In such a case the statute declares itself. We may not where no ambiguity exists search beyond the statute for a different meaning. Even hardship does not justify a court in reading into a statute something contrary to its unequivocal language. Only when the legislature sounds an uncertain trumpet may the court move in to clarify the call. But when the call is clear and certain as it is here we may not consider whether the statute as written comports with our ideas of justice, expediency or sound public policy. In such circumstances that is not the court's business. [Citations omitted.]" *Id.* at 369, 187 A.2d at 264-65.

Finally, Bethlehem turns to the constitutions of both the United States and the State of Rhode Island and argues that a retroactive application of § 9-21-10 amounts to denial of its due-process rights. A ready response to such assertions was made about a half century ago in *Funkhouser v. J. B. Preston Co.*, 290 U.S. 163, 168, 54 S. Ct. 134, 136, 78 L. Ed. 243, 246 (1933), where the United States Supreme Court, in upholding the retroactive application of a New York statute calling for interest, noted that the payment of interest was an appropriate subject for legislative action in that it added "an amount commonly viewed as a reasonable measure of the loss sustained through delay in payment." Thus, prejudgment interest serves two purposes: it promotes the early settlement of claims and compensates one for his inability to utilize funds rightly due him. Here, the trial justice, in relying on *Funkhouser*, remarked that in the present context of money markets "it can scarcely be said that a 12 percent rate of interest is unreasonable." We echo those sentiments.

We would also note that the due-process clause of our state's constitution, art. I, sec. 10, applies only to the rights of individuals involved in criminal prosecutions and not to civil actions. *Twomey v. Carlton House of Providence, Inc.*, 113 R.I. 264, 271, 320 A.2d 98, 101 (1974); *Avella v. Almac's Inc.*, 100 R.I. 95, 99-102, 211 A.2d 665, 668-70 (1965); *Ajootian v. Housing Board of Review*, 93 R.I. 370, 375, 201 A.2d 905, 908 (1964).

The cross-appeals are denied and dismissed. The amended judgment entered after the decision of the trial justice is affirmed. The case is remanded to the Superior Court.

Mr. Justice Weisberger[2] and Mrs. Justice Murray did not participate.

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[2] The Turnpike Authority instituted this suit on December 17, 1970, and the controversy first came on for trial on January 16, 1974. The trial justice through the ensuing 85 days of hearing was our colleague, Mr. Justice Weisberger, who was then the Presiding Justice of the Superior Court. He has continued to act as the trial judge during the two remand hearings.

I (B)

Opinion of Supreme Court of Rhode Island
Filed August 11, 1977. 119 R.I. 141, 379 A.2d 344

Rhode Island Turnpike and Bridge Authority	:	Supreme Court
v.	:	
Bethlehem Steel Corporation et al.	:	No. 76-201-Appeal.
v	:	
Walter S. Douglas et al., d.b.a. Parsons, Brinckerhoff, Quade & Douglas	:	

Opinion.

KELLEHER, J. Anyone who has been to Newport in the last several years knows that the once slow but scenic ferry which crossed from Jamestown to Newport has long since given way to the marvels of modern engineering. A graceful suspension bridge now spans the east passage of Narragansett Bay and links Jamestown to Newport. Unfortunately, even before the structure was completed, its paint began to flake and it was ultimately determined that within a short period of time virtually the entire bridge would have to be repainted. The one point on which all of the litigants and their respective experts agreed was that the Newport Bridge had suffered the most catastrophic paint failure known to any of them — no small claim to fame.

On December 17, 1970, the Rhode Island Turnpike and Bridge Authority (the Authority) filed suit against Bethlehem Steel Corporation (Bethlehem or the company),[1] alleging that on April 25, 1966, Bethlehem had entered into a contract with the Authority (the contract) and that Bethlehem had breached the contract. Under the contract Bethlehem agreed to fabricate and erect the bridge's superstructure. Among other things, Bethlehem was also bound to furnish all steel

[1] Throughout we shall refer only to Bethlehem, although its insurer, The Insurance Company of North America, was also named as a defendant.

for the project and was responsible for the surface preparation and application of paint to all ferrous metals and galvanized surfaces in accordance with the contract specifications. The Authority's basic contention was that Bethlehem had "failed adequately to prepare the surfaces required to be painted * * * failed properly to prepare and apply the paint in accordance with [the] specifications * * * [and] failed to do necessary remedial work." Originally, the Authority claimed damages of $2 million, but following completion of certain remedial work by a third party (Canon) [sic], the Authority amended its complaint and sought damages of $6 million.

Bethlehem denied all liability and additionally filed a counterclaim. Count I alleged that the Authority still owed Bethlehem $811,661.27 plus interest for work performed under the contract.[2] The second count charged that the Authority had contracted with an engineering firm, Parsons, Brinckerhoff, Quade & Douglas (Parsons or the Engineer), for engineering advice and services including the "preparation and design of an adequate and suitable paint system" for the bridge (Section 7 Specifications or paint system); that Parsons had prepared the paint specifications; and that the paint system was "developed and prepared in a negligent manner." Damages of $2.5 million, plus interest and costs, allegedly due from the Authority and Parsons were claimed. The third count alleged that due to the late delivery of certain tower and anchorage piers as well as to certain acceleration programs undertaken as a result of the delay, Bethlehem was prevented from performing its work in the manner and within the time planned. Therefore, the company claimed it had suffered a $4.5 million loss.

The trial justice, finding for the Authority and rejecting Counts II and III of the counterclaim, ultimately awarded the Authority $4,571,329.39. Bethlehem has appealed, claiming

[2] No error is claimed on appeal regarding this count.

errors relating to a discovery ruling, the trial justice's findings and conclusions in favor of the Authority and against the company, and the award of damages. We shall first address the discovery question; then we will turn to the Authority's complaint and Count II of the counterclaim (The Paint Controversy). Count III (The Delay Controversy) will be discussed separately as will the damages question.

I. The Discovery Question

Bethlehem alleges that the trial justice erred in refusing to allow the corporation to inspect certain diaries written by Parsons' Chief Field Engineer during 1971, 1972, and 1973, when he was largely responsible for overseeing remedial work, cleaning and repainting the steel, being performed by Cannon. Bethlehem had initially requested the diaries when the Chief Field Engineer was deposed and renewed the request at trial. Upon reading them, the trial justice ruled that under Super. R. Civ. P. 26(b)(2) they were not discoverable because they were "a writing prepared by the agent of a party in anticipation of litigation and in preparation for trial."

On appeal Bethlehem claims that this ruling is wrong because the volumes are discoverable in whole or in part as business records, and any portions of them covered by the work-product rule should simply have been excised. However, to qualify as a business record the writing must be kept in the ordinary course of business. *See Webbier v. Thoroughbred Protect. Bureau, Inc.*, 105 R.I. 605, 254 A.2d 285 (1969); *Douglas Furniture Corp. v. Ehrlich*, 91 R.I. 7, 160 A.2d 362 (1960); *Ostroff v. Stephen Girard, Inc.*, 79 R.I. 158, 85 A.2d 174 (1951). These diaries were part of the Chief Field Engineer's *personal* records; he maintained diaries on all sorts of subjects including nonwork-related readings and writings, family, physical exercise, and work responsibilities. These records were not part of Parsons' records; nor were

they maintained at Parsons' direction. Accordingly, they were not discoverable as business records. We, therefore, find no fault with the trial justice's ruling.

II. The Paint Controversy

A. *Misconceived issues of law and fact*

At trial the Authority contended that the failure of the paint to adhere to the steel was caused by contaminants on the steel prior to painting. The alleged contaminant was "mill scale" or a residuum thereof. Mill scale is similar to rust in that both are caused by oxidation of the steel, but unlike rust in that it is bluish-black in color. However, whereas rust occurs at normal everyday temperatures, mill scale occurs in the manufacturing process as the steel cools, when temperatures are greater than 1000° F. Mill scale is not, therefore, an unusual condition. The prime component of mill scale is the oxide FeO, but FeO is not always evident because it is an extremely unstable compound, which rapidly deteriorates. If chemical analysis reveals FeO, mill scale is present, but the absence of FeO does not preclude the presence of mill scale.

Paint systems most commonly used on bridges contain a linseed oil and red-lead base which is capable of penetrating mill scale, thereby helping the paint to adhere to the steel. Such systems generally have a high pigment volume concentration (PVC) which also helps the paint adhere to the surface. The Newport system was epoxy rather than linseed oil based and had a low PVC. Witnesses at trial agreed that an epoxy system had never been used on a bridge before; however, there was testimony that such systems had been used on ships and other marine structures and were in fact used on bridges subsequent to the painting of the Newport structure.

It was recognized that the epoxy system was not able to penetrate mill scale. Therefore, the steel used in the project would have to be free of mill scale, although the residual stain

could remain. This required cleaning of the steel to standard specifications (SSPC) 6 level,[3] and this requirement was part of the Specifications under which Bethlehem was to perform. Essentially, the Authority claimed that the SSPC 6 level had not been met, whereas Bethlehem argued that no competent engineer would have ordered a new and untested paint system for this bridge.

Bethlehem's first argument, that the trial justice misconceived issues of law and fact, is two-pronged: (1) the trial justice's ultimate finding as to the presence of mill scale or a residuum thereof was based on a purely conjectural preliminary finding, and (2) the trial court overlooked the distinctions between the claim and counterclaim and the burden of proof allocable to each of the parties.

In arguing that the findings as to mill scale were speculative, the company points to evidence adduced militating against its presence. Additionally, Bethlehem directs our attention to language in the trial court's decision which noted that the oxide FeO "might well disappear in the open air after a period of time." This further breakdown of the oxide would presumably account for its absence from the bridge's superstructure. Bethlehem strenuously maintains that FeO does not disappear into thin air as rapidly as the trial court suggests, but that even assuming the absence of FeO could logically be explained, a finding of "might well disappear" is insufficient to sustain the Authority's burden of proof. Had the trial justice based his conclusions solely on the instability of FeO, Bethlehem might have cause for complaint, but that simply is not the case. The question of whether the steel had been properly prepared was exhaustively litigated.

Numerous witnesses testified for and against the theory that mill scale or another contaminant was responsible for

[3] Incorporated and made part of the contract was the *State of Rhode Island Standard Specifications for Road and Bridge Construction, 1965 Revision*, commonly referred to as the "blue-book."

the paint failure. Quite simply, the question had to be resolved by weighing conflicting testimony. The trial justice did precisely this, and there was ample evidence on which he could base a finding concerning the presence of the mill scale. There was testimony that the paint system used on the Newport Bridge required an extremely careful job of surface preparation for the paint to adhere properly and that Bethlehem had encountered considerable difficulty with the blasting equipment it used to clean the steel. Witnesses also testified that examination of paint chip specimens from the bridge revealed the bluish-black substance on the underside of the chips was the oxide Fe_3O_4, which is usually the end product of corrosion. Moreover, the black substance conformed precisely to the contour of the paint, leading one to conclude that contaminants were on the steel when the paint was applied. There was expert testimony which identified the substance as mill scale. Finally, the trial justice gave great weight to motion pictures taken in 1974, which showed that the remedial work performed by Cannon was holding up extremely well where Bethlehem's had failed.

As noted earlier, we will not disturb a trial court's findings unless it is shown to be clearly wrong. In light of the foregoing evidence, we cannot say that the trial justice was engaging in speculation, and accordingly we will not disturb his finding that mill scale or other contaminants were on the steel before Bethlehem began to apply the paint.

The second aspect of Bethlehem's argument on this point concerns each party's burden of proof. Essentially, the company contends that the trial justice rolled into one the Authority's claim and Count II of Bethlehem's counterclaim, found that Bethlehem did not prove Count II, and concluded that, therefore, the Authority's claim was proven. This formulation of the trial justice's findings and conclusions misses the mark. While it is true the trial court spoke in terms of the

"sole controversy" being whether the paint failure was due to the faulty steel preparation and paint application or attributable to inherent deficiencies of the paint specifications themselves, it does not necessarily follow that he misperceived the respective burdens of proof. Indeed, quite the opposite is evident in his decision. After summarizing the evidence at length and making numerous findings of fact, the trial justice observed that "[a]lthough the plaintiff AUHORITY has the burden of proving by a fair preponderance of evidence that the paint failure was due to a faulty preparation of the steel by BETHLEHEM in that mill scale and other contaminants were not removed to an SSPC No. 6 level prior to the application of paint, it is not necessary that the plaintiff prove beyond a reasonable doubt that the contaminant in each instance was mill scale." The court then found that the Authority had met its burden, that contaminants were present at the time of painting, and that in most instances the contaminant was mill scale or a residuum thereof. Proceeding to Bethlehem's burden of proof on Count II, the trial justice observed that the company's attempt to show that the Section 7 Specifications were inherently inadequate was a "complete failure." He found the "overwhelming weight of the testimony" showed "almost beyond doubt" that the paint system designed by the Engineer was adequate for the Newport Bridge. He thus concluded that "the massive failure which took place by 1970 was due to faulty surface preparation and/or application on the part of BETHLEHEM, its employees and agents."

We are sure that the trial justice would be the first to admit that he treated the "paint controversy" as an entity. He summarized separately the evidence pertaining to it and made separate findings of facts and conclusions of law. We find no fault, however, with his treatment of the issue. The claim and counterclaim were not tried separately; all parties presented

evidence on the steel preparation as well as the paint specifications. To argue, as Bethlehem has, that the trial justice erred because he spoke in terms of the "sole controversy" is to pay homage to semantics. It is abundantly clear from the findings and conclusions recited above that the trial justice knew the task before him and performed it. We, therefore, reject the contention that the trial justice misconceived issues of law and fact applicable to the Authority's complaint.

B. *Estoppel*

Bethlehem next argues that even if it did fail to prepare or paint the steel properly, the Authority should be estopped from claiming such. In support of this contention, the company maintains that agents of the Authority inspected and approved the work, and any alleged defects would have been discoverable. Moreover, says Bethlehem, certain contractual provisions preclude the Authority from recovering damages following inspection and approval of the steel.

The Authority engaged inspectors from Pittsburgh Testing Laboratory (PTL) to inspect Bethlehem's cleaning, preparation, and painting of the steel at Bethlehem's Pottstown, Pennsylvania plant. A total of eight inspectors worked at the plant for approximately 2 years. Four men on the day shift, and two on the evening and night shifts, kept an eye on all operations concerning the Newport project. Their duty was to "spot check the cleaning and painting operations on more than one shift at unannounced times." The chief inspector of the Newport job estimated that approximately 10% of the steel was actually checked in various stages of cleaning and painting. The total amount of steel produced by Bethlehem for the Newport project was estimated to be 10,000 to 10,200 pieces. Thus, approximately 1,000-1,200 pieces were spot checked. Of these, about 842, 70-84%, were found unsatisfactory by the PTL inspectors.

Bethlehem inspectors were also on the job. The company had designed a system for keeping track of when its own or PTL employees checked material. Each steel member was marked with a yellow tag, which Bethlehem said signified the steel was ready for painting. The tags had places for inspectors to mark which coat of paint they had approved. There was no specific place for noting that cleaned but unpainted steel had been checked and approved. PTL's chief inspector testified that his men did not check all steel prior to Bethlehem's yellow-tagging, and PTL workers themselves never yellow-tagged anything. There was, however, another tagging procedure — the red tag. It signified that PTL had visually inspected the finished product, found it suitable, and was releasing it for shipment. Later, in the fall of 1969 the Engineer inspected and approved a large segment of the bridge and thereafter released a portion of the contract retainage applicable to the completed areas.

Based on this inspection and approval, Bethlehem maintains that because the defects were discoverable, the Authority is precluded from recovering remedial costs after the steel was incorporated into the structure. An examination of the cases cited by Bethlehem as well as numerous others fails to persuade us to this point of view. In those cases where the owner was estopped from asserting breach, one or more of several circumstances was present: (1) each piece of material was subject to careful examination; (2) the owner, in effect, was challenging the very specifications which he had mandated and which the work product had met; (3) the inspecting party did not object or complain about any of the work. Had PTL inspected each piece of steel prior to painting and never complained about the workmanship, we might well be faced with a situation where the owner had lulled the contractor into a false sense of assurance. But in this case quite the opposite is evident. All parties involved knew that PTL was only spot checking. Furthermore, the inspectors hardly closed

their eyes to discrepancies, demanding that at least 70% of the work inspected receive remedial treatment. Bethlehem cannot now be heard to claim it was led down the proverbial primrose path.

Nor can the Engineer's partial acceptance of the work bar the Authority's claim, for the contract specifically provides that:

> "Any approval by the engineer of any materials, workmanship, plant, equipment, drawings, programs, methods or procedure, or of any other act or thing done or furnished, in or in connection with the performance of the work, *shall be construed merely to mean that at the time the Engineer knows of no good reason for objecting thereto; and no such approval shall release the Contractor from his full responsibility for the accurate and complete performance of the work in accordance with the Plans and Specifications* or from any duty, obligation or liability imposed upon him by the provisions of the contract." (Emphasis added.)

It is evident from this provision that defects of which the Engineer was not cognizant can be the subject of a complaint subsequent to the Engineer's approval. Bethlehem does not contend, nor do we think, that the Engineer was under a duty to test the steel once it was incorporated into the bridge. The Engineer had a right to believe Bethlehem had fulfilled its side of the contract. Bethlehem seems to rely on the notion that the defects were discoverable, but we have not been shown any testimony which would establish that a visual inspection of the bridge would reveal the presence of mill scale under three coats of paint.

Bethlehem, however, makes yet two more arguments. The first is that the special contract provisions relating to paint and painting envisioned the possibility of dispute and pro-

vided for arbitration.[4] Thus, says the company, it is unfair to allow claims for deficient work long after the event when such work failures could have been remedied at an earlier time. The only problem with their theory is that no dispute within the meaning of the section ever arose. The chief inspector noted that whenever PTL requested remedial work, it was done.

Finally, Bethlehem points to sec. 106.04 of the Standard Specifications relating to "Plant Inspection." This section provides that despite any plant inspection and acceptance, the Authority may retest the material at the site and, prior to the material's incorporation into the structure, reject defective work. Bethlehem maintains that under this provision, the Authority cannot reject the company's product once it is built into the bridge. We are constrained to disagree with Bethlehem on this point. Standard Specification 105.16(b), relating to final acceptance, reads in pertinent part:

> "Upon due notice from the Contractor of presumptive completion of the entire project, the Engineer will make an inspection* * *.
>
> "If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, the Engineer will give the Contractor the necessary instructions for correction of same, and the Contractor shall immediately comply with and execute such instructions."

Reading this section in conjunction with sec. 106.04, cited by Bethlehem, we conclude that the "Plant Inspection" provi-

[4] This section provides in part: "All work under this specification shall be subject to inspection by the owner or his representative. All parts of the work shall be accessible to the inspector. The contractor shall correct such work as is found defective under the specifications. If the contractor does not agree with the inspector, the arbitration or settlement procedure established in the contract, if any, shall be followed. If no arbitration or settlement procedure is established, the procedure specified by the American Arbitration Association shall be used."

sion provides merely that plant approval is not final. Furthermore, sec. 106.04 does not mandate the Authority to test every piece of steel before it collectively becomes a bridge, or the Authority forever hold its peace. The final acceptance provision clearly envisions the possibility of remedial work "in the air."

Accordingly, we reject Bethlehem's argument that the Authority is estopped from asserting its claim.

C. *Counterclaim*

Bethlehem also contends that the trial justice erred in dismissing Count II of the counterclaim wherein the company alleged that the paint system "was developed and prepared in a negligent manner and not in accordance with the usual and customary standards of care and professional competence." On appeal Bethlehem argues that the Engineer was negligent as a matter of law. It is well established that negligence is ordinarily a question of fact, *Ferreira v. McGrath Truck Leasing Corp.*, 104 R.I. 642, 247 A.2d 842 (1968), and it is only when the evidence presented and reasonable inferences therefrom are susceptible of only one conclusion that it becomes a matter of law. *See Garris v. Gloss*, 111 R.I. 453, 303 A.2d 765 (1973); *Waltz v. Ayerigg*, 103 R.I. 109, 235 A.2d 338 (1967).

Bethlehem contends that the trial justice did not find the Engineer *not* negligent, but "simply found that the paint specifications were adequate." In fact, the court in dismissing this count of the counterclaim found the specifications "adequate and suitable for the purpose for which they were intended." We fail to see how a company that designed a paint system which the trial justice specifically found to be "adequate and suitable" for its purposes could be negligent as a matter of law, but in any event we find the trial justice's conclusions amply supported by the evidence.

There was abundant testimony tending to show that the paint system was properly designed. Even the so-called "father of epoxy coatings," noting the marine environment, stated unequivocally that the paint system was not just adequate but "excellent for * * * the bridge." Evidently the trial justice found the experts on behalf of the Authority and Parsons more persuasive, for he commented that on the whole they were more experienced and qualified than Bethlehem's principal witnesses, with the possible exception of one particular Bethlehem employee who was the coatings expert of that company's own research laboratory. This employee, however, had in fact approved the paint specifications. As the trail justice observed, "[h]ad the specifications been so inherently and obviously defective" as is now asserted, this employee would have been qualified and "in a position to point this out very quickly."

In our opinion, even a cursory examination of the foregoing evidence reveals that the trial justice could well find the specifications "adequate and suitable" and not negligent as a matter of law or fact. Therefore, we affirm his rejection of Count II of the counterclaim.

III. The Delay Controversy

We come now to the "Delay Case" and Bethlehem's contention that the trial justice erroneously dismissed the third count of the counterclaim. This particular claim resulted from the fact that another contractor (Perini) was tardy in furnishing six tower and anchorage piers on which Bethlehem was to construct the superstructure. Bethlehem argues that the Authority had promised that the piers would be completed within a certain time. Bethlehem's complaint and answers to interrogatories indicated that the company's alleged injury revolved around these six key piers; however, during trial the company was allowed to introduce evidence of damages flow-

ing from belated delivery of all the piers. Bethlehem's complaint also charged that the Authority demanded that Bethlehem accelerate its work schedule to compensate for time lost on account of Perini as well as other contractors and, subsequently, when the acceleration program was frustrated by circumstances beyond Bethlehem's control, the Authority abandoned the program. According to the company, these "acts and omissions * * * unreasonably delayed and actively interfered with the performance of Bethlehem's work and prevented Bethlehem's timely and economical performance of the Contract."

The initial contract with Perini, concerning the six basic piers, was signed prior to the Authority's contracting with Bethlehem for the latter's construction of the superstructure. That contract with Bethlehem provided in part: "Tower piers 1W and 1E are scheduled for completion about October 30, 1966 and piers 2W, 2E, Anchorage Piers 4W and 4E are scheduled for completion about January 30, 1967." Contracts for the other piers and concrete work were awarded to Perini, Gammino Construction Company (Gammino) and Coleman Brothers Corporation (Coleman) between September 1966 and March 1967, after Bethlehem had been retained.

First we will deal with Bethlehem's argument that the contract provision quoted above constituted an implied promise to furnish the piers on approximately the dates specified. This would mean that the Authority would be warranting the timeliness of work outside its control. However, it is hardly "within the realm of normal expectation" that the Authority would "voluntarily stand as a guarantor of the performance of its contract by another contractor within a specified time." *Gilbane Building Co. v. United States*, 333 F.2d 867, 869 (Ct. Cl. 1964), *citing H. E. Crook Co. v. United States*, 270 U.S. 4, 46 S. Ct. 184, 70 L. Ed. 438 (1926). It has also been said that the government will not be held liable unless the contract can

be interpreted as implying an unqualified warranty to make the work in question available. *United States v. Foley*, 329 U.S. 64, 67 S. Ct. 154, 91 L. Ed. 44 (1946).

In *Gilbane* the disputed language provided that work under another contract "will be completed and the site available to commence work specified under this contract on November 22, 1954." *Gilbane Building Co. v. United States, supra* 869. The court in that case found that those were not words of warranty. The contract provision on which Bethlehem relies is, if anything, less compelling than that in *Gilbane*. In light of the foregoing authorities, we cannot accept the premise that the Authority gave an unqualified promise to Bethlehem that Perini's work on the first six piers would be available on certain dates. The Authority may have represented that the work would be done at a specified time, but there was no guarantee. *Gilbane Building Co. v. United States, supra*. Thus, we find no fault with the trial justice, who concluded that the schedules set forth in the bid documents were by way of information and did not purport to constitute a promise, guarantee or warranty.

Secondly, we conclude that a provision of the contract specifically precludes Bethlehem from holding the Authority accountable for any delays caused by other contractors, including here Perini, Gammino, and Coleman. This provision is not limited to the first six Perini piers, but covers also damages relating to late delivery of all the piers.

Paragraph 105.07 of the Standard Specifications reads in pertinent part:

> "When separate contracts are let within the limits of any one project, each contractor shall conduct his work so as not to interfere with or hinder the progress or completion of the work being performed by other contractors. Contractors working on the same project shall cooperate with each other as directed.

> "Each contractor involved shall assume all liability, financial or otherwise, in connection with his contract and shall protect and save harmless the Department from any and all damages or claims that may arise because of inconvenience, delay, or loss experienced by him because of the presence and operations of other contractors working within the limits of the same project."

Arguing that this provision is inapplicable, Bethlehem maintains: (1) the word "project" in the second quoted paragraph means Bethlehem's contract and does not, therefore, pertain to delays resulting from other contracts, specifically those with Perini, Gilbane, and Coleman; (2) paragraph 105.07 is a "protect and save harmless" clause, which in this case the company claims is only an indemnification provision,[8] rather than a "no damages for delay" clause; and (3) even if this is a "no damages" clause, it should not apply here because the delays were unreasonable.

We note first that Bethlehem's interpretation of "project" does not withstand scrutiny. Reading the two quoted paragraphs together, one can see that paragraph 105.07 envisions the awarding of more than one contract within a given project, which in this case was the construction of the Newport Bridge.

Secondly, the company's "protect and save harmless" argument does not hold water. A close reading of the language in question makes it apparent that the provision exculpates the Authority:

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[8] Bethlehem also contends the section is inapplicable because the company is not complaining of delay caused by other contractors, but rather is basing its claim on the "fact" that the Authority made certain representations on which it intended the company to rely. We do not deal with this argument because Bethlehem *does* base its argument on the delay of other parties and we have already ruled that the Authority did not make any guarantee vis-a-vis the piers.

> "Each contractor involved [Bethlehem] * * * shall protect and save harmless the Department [Authority] from any and all damages or claims that may arise because of inconvenience, delay, or loss, experienced by him [Bethlehem] because the presence and operations of other contractors [Perini et al.] working within the limits of the same project."

The interpretation Bethlehem urges, i.e. a classic indemnification clause, would mean that Bethlehem would indemnify the Authority in case of any claims by Perini et al. That simply is not a sensible reading of this section.

The company's third contention on this point is also without merit. Even assuming, *arguendo*, that "delay" is to be construed as meaning "reasonable delay," we cannot say as a matter of law that based on all the evidence presented below this delay was unreasonable. The original construction schedule presented by Bethlehem projected completion of the bridge around April 30, 1968. Under the various acceleration programs adopted by Bethlehem and the Authority, the bridge was to be ready on August 2, 1968. Further delay was due to circumstances outside the control of the Authority, Bethlehem or any of the other contractors: certain iron workers on the deck contract went on strike. Thus, barring the strike, the delay in completion of the bridge would have been only 3 months. Furthermore, Bethlehem has presented us with no evidence suggesting that it was precluded from beginning work, or sat idle for significant periods of time during the construction period. Thus, we conclude that paragraph 105.07 prevents Bethlehem from recouping from the Authority any losses due to delay in pier delivery.

Another of Bethlehem's contentions was based not upon delayed delivery of the major piers, but rather on costs incurred for work (bush hammering)[6] beyond the scope of the

[6] "Bush hammering" refers to a technique whereby the concrete piers which support the bridge's superstructure are ground down to precise elevations.

contract. The trial justice, finding that there was an ambiguity in the contract concerning the work, concluded that if Bethlehem considered this "extra work," then a timely claim for compensation should have been made under paragraph 105.17 of the Standard Specifications.[7] Since no claim was made until sometime during trial, the claim was waived. Bethlehem has not shown us that the trial justice misconceived or overlooked material evidence or was otherwise clearly wrong. The company recognizes that the bush hammering was "extra work," but has not even alleged compliance with paragraph 105.17. Therefore, we affirm the trial justice's ruling as to the bush hammering.

Finally, we come to that portion of Bethlehem's argument wherein they maintain that the delays discussed above plus the undertaking and subsequent abandonment of various acceleration programs constituted unreasonable delay and active interference.

Having previously addressed the delay questions, we will deal now only with the alleged "active interference." We note first that despite Bethlehem's claims to the contrary, the company was not *ordered* to accelerate its work. The record amply supports the finding that Bethlehem and the Authority agreed to the various acceleration programs after numerous meetings and exchanges of correspondence. Bethlehem has not shown us that the trial justice was clearly wrong in concluding that "the AUTHORITY and PARSONS did not ac-

[7] "If, in any case, the Contractor deems that additional compensation is due him for work or material not clearly covered in the contract or not ordered by the Engineer as extra work, as defined herein, the Contractor shall notify the Engineer in writing of his intention to make claim for such additional compensation before he begins the work on which he bases the claim. If such notification is not given, and the Engineer is not afforded proper facilities by the Contractor for keeping strict account of actual cost as required, then the Contractor hereby agrees to waive any claim for such additional compensation."

tively interfere with the work of the project, but did everything within their power to promote, implement and accelerate such progress throughout the life of the entire project."

Based on the foregoing analysis, we conclude that the trial justice properly dismissed Count III of the counterclaim and, accordingly, we will not address other rulings made by the trial justice on this matter or Bethlehem's objections to them.

IV. Damages

The final award of damages, as determined by the trial justice, gave the Authority $4,571,329.39 plus costs.[8] This was determined as follows:

Phase I — Remedial Painting Costs incurred to date	$2,342,370.63
Engineering costs incurred	232,037.00
Phases II, III, IV[9] — Estimated future remedial painting costs	2,215,000.00
Estimated engineering costs	275,000.00
	$5,064,407.63
Credit to Bethlehem under Count I of the counterclaim	804,996.55
	$4,259,411.08
Interest on sums for painting under Phase I	283,569.47
Interest on sums for engineering under Phase I	28,348.84
TOTAL	$4,571,329.39[10]

[8] Parsons was also awarded costs under Count II of the counterclaim, but that award is not contested.

[9] The remedial work was broken into four phases, the first of which had been completed at the time of trial. Phases II-IV are referred to as future remedial costs.

[10] The trial justice awarded interest on amounts due over and above the credit to Bethlehem, at the rate of 6% from the time various payments were made until December 31, 1975.

The trial justice specifically found these costs reasonable in amount and reasonably necessary to restore the bridge to the condition it would have been in had Bethlehem fulfilled its contractual obligations.

Bethlehem contends initially that an award of over $4.5 million is grossly disproportionate to the approximately $19 million the company received for all its work under the contract. Relying on the doctrine of economic waste and related theories, Bethlehem suggests that where the cost of repair is great, or the remedial effort involves unreasonable expense, the proper measure of damages is the difference in value between what the bridge was worth as completed and what it would have been worth if completed in accordance with the specifications.

We are not convinced that this is a case of economic waste. Justice Cardozo, in perhaps the classic of such cases, observed that difference in value is the measure of damages where the cost of completion is grossly and unfairly out of proportion to what will be attained. *Jacob & Young v. Kent*, 230 N.Y. 239, 129 N.E. 889 (1921). In that case, Kent had contracted for a house with Reading pipe installed therein, but the builders instead used Cohoes pipe, which was substantially the same. To remedy the situation would have been to tear down the inner walls of the house, replace the plumbing, and rebuild the structure. The case before us is hardly one of Reading pipe. *See also Salem Towne Apts., Inc. v. McDaniel & Sons Roofing Co.*, 330 F. Supp. 906 (E.D.N.C. 1970).

Nor can we say that simply because the damages are approximately 25% of Bethlehem's contract fee they are necessarily disproportionate. *See Johnson v. Flammia*, 169 Conn. 491, 363 A.2d 1048 (1975). While the cost of repair is great, we cannot find as a matter of law that it is unreasonable. Without a doubt, Canon's remedial work differed in one very material aspect from the task Bethlehem confronted. Where-

as Bethlehem performed its job in the plant and on the ground, working on individual steel members, Canon's work was in the air, and all parties would agree the remedial work was infinitely more difficult.[11] Indeed, that was part of the thrust of Bethlehem's argument, i.e., it would have been far easier (and less expensive) to correct any defects in the shop, prior to construction.

Finally, Bethlehem has not pointed to any testimony which would show that the difference in value estimate would be any different from what the trial justice awarded. For us to hazard a guess on the value of the Newport Bridge with a flaking paint job would be unconscionable speculation. Thus, we find no error with the trial justice's method of awarding damages.

Secondly, Bethlehem contends that insofar as Phase I is concerned, Canon expended material and effort in excess of what the contract required and that remedial costs were, therefore, excessive. In support of this contention, the company points to purportedly undisputed testimony that Canon cleaned the steel to a greater degree and applied more paint than was required. On the contrary, our review of the record shows that the testimony was conflicting. Furthermore, in our opinion, such costs are unreasonable only when material and labor are expended "beyond what in reason and good workmanship was contemplated by the original contract." *Plymouth Village Fire District v. New Amsterdam Cas. Co.*, 130 F. Supp. 798, 802 (D.N.H. 1955). Certainly, what was contemplated by the contract in this case was a serviceable paint job. In light of all the circumstances involved, we do not think that the trial justice was clearly wrong in finding the remedial costs reasonable.

[11] The remedial work was most definitely "in the air"; the center span is 215' 8" above water, and the two main towers holding the suspension cables reach 400' above the bay. See Appendix.

Bethlehem also maintains that the $232,037 awarded for engineering costs related to Phase I is without basis in the record. We must agree. Although the record reveals confusion on the matter, our reading of it indicates that the figure of $232,037 was Parsons' in-house estimate; only $212,872 was actually billed and paid. In light of the fact that the damages issue will be remanded on other grounds, we will not make any adjustment to the award. The trial justice, in reconsidering various other facets of the award, shall take this error into consideration.

Bethlehem's fourth argument is that the Authority was under a duty to mitigate damages by using a "conventional red lead system" for the repairs rather than the more expensive epoxy system required under the contract. We find no merit to this argument and see no reason why the Authority should have to settle for something less than it bargained for, the epoxy system being designed to withstand better the rigors of Narragansett Bay's climate. It is well established that the rule concerning damages is designed to place the injured party in *as good a position as he would have been* in had the contract been fully performed as promised. 5 Corbin on Contracts § 992 (1964).

Next Bethlehem argues that damages should have been based on costs at the time of breach, 1966-1968 when the work was originally done at the Pottstown plant, rather than based on 1971-1973 prices when remedial work was done and on estimated future costs. Along those lines we recently held that where there was injury to real property, damages should be assessed as of the time of injury rather than the time of judgment. *Tortolano v. DiFilippo*, 115 R.I. 496, 349, A.2d 48 (1975).

The basic problem we have with Bethlehem's argument is the premise that the breach occurred in 1966-68 at the time of cleaning and painting the steel. While the question of time of

the breach was not considered by the trial justice, we have no trouble upholding his award in this regard. The breach as it affects remedial work could not possibly have occurred until Bethlehem left the job in the fall of 1970, refusing to do any further work, in violation of its remedial duty under the contract. At that time the Authority began its search for another contractor who performed the remedial work in the ensuing painting seasons. Accordingly, the 1971-1973 and estimated costs were not "inflated costs" due to unreasonable delay in making repairs. *See Gaylord Builders v. Richmond Metal Mfg. Co.*, 186 Pa. Super. 101, 140 A.2d 358 (1958).

Bethlehem, however, claims several other errors regarding damages awarded for future painting and engineering costs. The first of these is that no award should be made for future painting costs because Bethlehem did not guarantee the life of the paint. In our opinion, a guarantee is not necessary. The Authority contracted for a paint job estimated to last up to 15 years, but as a result of Bethlehem's breach, the work fell far short of that expectation. Therefore, some allowance for future costs is proper.

On the other hand, the Authority has received some benefit from Bethlehem's work; the paint has lasted a few years, the duration varying in different sections of the bridge. Accordingly, Bethlehem must receive some credit for the benefit bestowed. Canon's costs should be prorated over the expected life of the remedial paint job, and Bethlehem should be charged only that portion allocable to the shortfall of its own work. *See 525 Main Street Corp. v. Eagle Roofing Co.*, 34 N.J.

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[13] In *Tortolano v. DiFilippo*, 115 R.I. 496, 349 A.2d 48 (1975), the plaintiff received an estimate for repairs to a retaining wall at the time of injury, but 2 years later at trial still had not made repairs. In *Gaylord Builders v. Richmond Metal Mfg. Co.*, 186 Pa. Super. 101, 140 A.2d 358 (1958), the court found the defendant had failed to mitigate by having the contract completed at the time of breach rather than waiting approximately 4 years.

251, 168 A.2d 33 (1961).[13] Because the trial justice did not make findings as to the expected life of Bethlehem's or Canon's work under the Section 7 Specifications, we remand the case for further findings and assessment of damages in accordance with this rule.

Bethlehem also claims that future painting costs were erroneously calculated because square footage figures on which estimates were based were taken out of thin air and certain contingency factors[14] which raised the costs were considered twice. Although mathematical exactitude is not required, the damages must be based on reasonable and probable estimates. *See Pescatore v. MacIntosh*, 113 R.I. 139, 319 A.2d 21 (1974); *Bertozzi v. McCarthy*, 164 Conn. 463, 323 A.2d 553 (1973). We have reviewed the testimony and exhibits pertaining to the square footage calculations and are at a loss to determine their reasonableness. Therefore, we direct the trial justice on remand to clarify his finding that the estimates were reasonable by setting forth the evidence on which he based that finding. On the other hand, there was testimony from which the trial justice could conclude that the various contingency factors added to the calculations for Phases II, III, and IV were reasonable and not duplications. Thus, we find no error insofar as the estimates reflect consideration of those factors.

Nor do we find any error, as is claimed, in the $275,000 awarded for future engineering costs. Despite Bethlehem's protestations to the contrary, there is sufficient testimony in the record to warrant the trial justice's finding that this estimate is reasonable.

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[13] Thus, if Bethlehem's work should have lasted 10 years, but repainting was necessary after 2, Bethlehem can be charged only 80% of the remedial cost.

[14] These contingency factors included consideration of surfaces which would not be included in the square-foot calculations, as well as costs due to necessary rigging, scaffolding, etc.

Bethlehem also claims, however, and the Authority agrees, that the trial justice in awarding damages under Phase IV included portions of the structure which the parties stipulated were not in dispute. Thus, on remand the trial justice shall determine the extent of the stipulation as well as the cost allocable thereto and reduce the award accordingly.

Bethlehem's final contention concerning damages for future remedial costs is that the award should be discounted in consideration of the fact that the Authority will have use of the money. We agree that the award must be reduced to present worth, allowing only that sum which, with the accumulation of interest, will amount to such damages as will in the future be sustained. *Gregorius v. Safeway Steel Scaffolds Co.*, 409 Pa. 578, 187 A.2d 646 (1963). *See also Petition of U.S. Steel Corp.*, 436 F.2d 1256 (6th Cir. 1970); *Brodie v. Philadelphia Transp. Co.*, 415 Pa. 296, 203 A.2d 657 (1964).

Bethlehem's last assertion of error is that although the trial justice awarded the Authority interest on money paid to Canon over and above the money due to Bethlehem under the counterclaim, the trial court did not award Bethlehem interest on the $804,996.55 from the date it was due, October 1970, until it was paid to Canon. Bethlehem bases its argument that interest is due on the premise that the counterclaim was liquidated and independent of the Authority's claim. There is merit to this contention. *See W K Contracting Co. v. Ashland Oil Refining Co.*, 478 F.2d 1046 (6th Cir. 1973); *Eastmount Constr. Co. v. Transp. Mfg. & Equip. Co.*, 301 F.2d 34 (8th Cir. 1962); *Carpenter v. Mass. Bonding & Ins. Co.*, 161 Me. 1, 206 A.2d 225 (1965); *Pearson v. Ryan*, 42 R.I. 83, 105 A. 513 (1919). Although the cases reviewed involved situations where the party claiming interest was the net victor, we fail to see why the net outcome should alter the legal principles involved.

The Authority had use of the $800 thousand plus until it began to pay Canon. As those payments proceeded, the Authority had use of less and less of the $804,996.55, until the time when the sum was exhausted. At that time, Bethlehem's credit ran out, and principal and interest began to accrue in favor of the Authority. Therefore, we direct the trial justice on remand to award Bethlehem interest on such sums as the Authority had use of until the Bethlehem credit was exhausted.

The defendant's appeal is affirmed in part and denied in part, and the case is remanded to the Superior Court for further consideration in accordance with this opinion.

(Illustration of Newport Bridge)

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Opinion of Supreme Court of Rhode Island
Filed June 10, 1980. 415 A.2d 1295

Rhode Island Turnpike and Bridge Authority	:	Supreme Court
v.	:	No. 79-181-Appeal.
Bethlehem Steel Corporation et al.	:	

Opinion.

KELLEHER, J. Figuratively speaking, this appeal marks the second time we have crossed over the Newport Bridge with our eyes fixed ever upward at the bridge's superstructure. The current dispute in essence, involves the assessment of damages due the Rhode Island Turnpike and Bridge Authority (the Authority) for the failure of Bethlehem Steel Corporation (Bethlehem or the company) to prepare the surface of the bridge's steel work properly for painting when the steel was being processed sometime in the late 1960s at Bethlehem's Pottstown, Pennsylvania, plant. We made our initial figurative crossing in *Rhode Island Turnpike and Bridge Authority v. Bethlehem Steel Corp.*, ___ R.I. ___, 379 A.2d 344 (1977), amidst falling paint chips and as witnesses to what all the experts agreed was the most catastrophic paint failure in the bridge-building business. In that case, we affirmed the trial justice's factual finding that the Authority's loss was due to Bethlehem's failure to clean the steel surface to the specified degree, thereby leaving on the surface the contaminant mill scale which eventually caused the paint failure. We remanded the case to the Superior Court for a determination of a number of issues dealing with the cost of correcting Bethlehem's negligence.

During the interim between remand and the trial justice's consideration of the remand, the remedial steps were completed. Thus, as we begin our second excursion, the steel work has been completely recleaned and repainted. The sole question presently before us is the amount of credit due Bethlehem for the benefit the Authority received from the original paint job.

The trial justice, in making this computation, found that the original paint covering afforded some degree of protection to the bridge for three years. He also determined that the Authority had contracted for a paint job that should have lasted twelve years. Consequently, he concluded that Bethlehem deserved a credit of 25 percent of the amount of remedial painting cost. The trial justice also found that the Authority's remedial painting cost amounted to $5,512,158.04; from this sum he deducted the 25-percent credit of $1,378,039.51 and then ordered an entry of judgment in favor of the Authority for $4,134,188.53. Both Bethlehem and the Authority have taken appeals from the trial justice's approach to the credit calculation.

Bethlehem objects to the use of the 25-percent figure to calculate the amount of credit to which it is entitled. The company urges the adoption of a variable, rather than a fixed formula for computing the credit. In promoting this approach, Bethlehem notes that the remedial painting was done in stages. The first repainting occurred in 1971. Thereafter, the painters returned to the bridge spasmodically and did their chores in 1972, 1973, 1975, 1976, and finished the job in 1977. Everyone concedes that the starting point for determining the amount of any credit due Bethlehem is July 1, 1968.

Bethlehem's formula envisions the repainting project as beginning at the Newport end of the span in 1971 and proceeding in a westerly direction until the painters reached the Jamestown terminus of the bridge. Bethlehem concedes, for the purposes of establishing its formula, that the expected life of the original paint job is twelve years. Since the first phase of the repainting occurred in 1971, or three years after the July 1, 1968 target date, Bethlehem seeks a 25-percent credit on the remedial costs incurred by the Authority during 1971. Similarly, Bethlehem seeks a 33⅓-percent credit for the work done in 1972, a 41⅔-percent credit for the 1973 costs, a 58⅓-percent credit for the 1975 work, a 66⅔-percent credit for the 1976 job, and a 75-percent credit for the final

phase of the repainting project.[1] This variable formula is based upon the supposition that since the repainting occurred over a number of years, the Authority had the benefit of the original paint applied by Bethlehem for various portions of time depending upon the year the original paint was removed.

While we admire the company's ingenuity, the formula it endorses affords it a damage credit far in excess of that to which it is entitled. This result occurs because the formula credits Bethlehem for time beyond which the Authority received any benefit from the paint. In computing the credit, the essential time element is not the number of years that portions of the original coat of paint remained on the bridge, but rather the amount of time that Bethlehem's paint job as a whole served some useful function. This approach best serves the meaning of the term "credit." Bethlehem can only claim credit for that benefit which it has bestowed upon the Authority, that is, the useful life of the original paint.

Bethlehem cites the cases of *Allied Chemical Corp. v. Van Buren School Dist. No. 42*, 264 Ark. 810, 575 S.W.2d 445 (1979). *525 Main Street Corp. v. Eagle Roofing Co.*, 34 N.J. 251, 168 A.2d 33 (1961), *Bloomsburg Mills, Inc. v. Sardoni Construction Co.*, 401 Pa. 358, 164 A.2d 201 (1960), in support of the proposition that credit should be based on the time of replacement rather than the time of failure. These cases dealt with leaking roofs that were repaired until further repairs became futile and roof replacement was in order.

[1] The 25-percent figure is calculated by dividing the number of years during which the paint replaced in 1971 was on the bridge by the expected life of the original paint, or 3/12. Similarly, the 1972 figure of 33⅓ percent is derived by dividing the four years the paint replaced in 1972 was on the bridge by the expected life of the original paint, or 4/12. The remaining percentages were computed in the same manner. Apparently, no remedial painting was conducted in 1974.

Credit for a defendant was calculated on the basis of the amount of time the plaintiff enjoyed the use of the roof, which was coincidentally also the time of replacement.

In such a large operation as repainting the Newport Bridge, the time of replacement cannot coincide with the time of failure. To permit Bethlehem credit for the extra time required to cure its contract breach would wrongfully allow the company to benefit from the fortuitous fact that it takes a lot of time to paint a 2½-mile-long bridge, buffeted by wind and waves, whose center span is 215 feet above the waters of Narragansett Bay, and whose two main towers reach skyward for an additional 185 feet.

Bethlehem's variable formula ranks second when measured against the trial justice's well-supported factual finding that the original paint job served no useful function after three years. At least five witnesses, one of whom described the original paint as "coming off in the breeze," testified that this paint provided no benefit to the bridge after 1971. Indeed, two witnesses were of the opinion that by 1971 the paint not only ceased to protect the bridge's steel structure but created an additional burden. In light of the record, we reject Bethlehem's formula.

In its cross-appeal the Authority claims that the trial justice erred in calculating the monetary value of Bethlehem's credit on the basis of the entire cost of the remedial paint job. Specifically, the Authority contends that this credit should only be applied to the actual cost of repainting, exclusive of the cost of sandblasting the surface of the steel work to receive the paint. We believe there is merit to this position. The exclusion of the cost of sandblasting from Bethlehem's credit would place the Authority in as good a position as it would have been had the contract been fully performed. 5 Corbin, *Contracts* § 992 (1964).

The Authority contracted both for steel work surface cleaned to the "(SSPC)6" level and for approximately twelve years of serviceable paint. Instead, it received a paint job of three years' duration owing to Bethlehem's failure to rid the steel surface of the contaminant called mill scale. Through the remedial work of the 1970s the bridge's steel, which was finally cleaned to the required specifications, was coated with a paint having a useful life of approximately twelve years. Thus, in total, the Authority received the specified steel surface of fifteen years' worth of paint. Since it bargained only for the specified surface and twelve years of paint, the Authority's windfall is three years of paint. Bethlehem is entirely responsible for the sandblasting expense, and its credit, in our opinion, must, therefore, be limited to 25 percent of the cost of actually applying the paint to the bridge's surface.

The Authority claims that this court can make the necessary computations without the need of a remand; Bethlehem thinks otherwise. While this litigation has occupied the attention of Rhode Island's judiciary for what seems to be an extremely lengthy period of time, and even though we are wary of the possibility of a third crossover, it is our belief that there may be factual issues requiring resolution in order to accurately calculate Bethlehem's credit. After remand, the trial justice may, if he deems it necessary, require the presentation by the litigants of additional evidence.

The Authority's appeal is sustained, Bethlehem's appeal is denied, the judgment appealed from is vacated, and the case is remanded to the Superior Court for further proceedings consistent with this opinion.

Mr. Justice Weisberger and Mrs. Justice Murray did not participate.

II (A)

Decision of Superior Court Filed June 26, 1981.

State of Rhode Island and
Providence Plantations

Newport, Sc.		Superior Court
Rhode Island Turnpike and Bridge Authority	)	Civil Action File No. 70-237 (Transferred to Providence County)
v.	)	
Bethlehem Steel Corporation and Insurance Company of North America	)	

Revised Decision.

WEISBERGER, J. This case comes before the court on a remand order issued by the Supreme Court in *Rhode Island Turnpike and Bridge Authority v. Bethlehem Steel Corporation et al.*, ____ R.I. ____, 415 A.2d 1295 (1980), wherein the court directed the trial justice[1] to reduce a credit previously given to Bethlehem Steel Corporation (Bethlehem) by elimination of that portion of the credit which applied to elements other than "the cost of actually applying the paint to the bridge's surface." *Id.* at 1298. The remand order authorized the trial justice to require the presentation by the litigants of additional evidence, where necessary.

Rhode Island Turnpike and Bridge Authority (the Authority) argued that under the terms of the remand order, no additional evidence was necessary. However, both parties conceded that the cost of applying paint would include an element of cost for surface preparation under normal maintenance circumstances. Such surface preparation would include an in-

[1] The trial justice is no longer a member of the Superior Court, but jurisdiction to complete this case on remand is retained pursuant to the provisions of G.L. 1956 (1969 Reenactment) § 8-2-26.

crement which might be termed *maintenance* sand blasting as opposed to *remedial* sand blasting.

It was also apparent from the record that no evidence had been introduced by the parties which could support a specific finding as to the distinction in cost between maintenance surface preparation and sand blasting on the one hand, and remedial surface preparation and sand blasting which was made necessary in order to remove the initial contaminants from the surface of the steel. The defendants also argued that the allocation of costs between sand blasting and painting had not been made clear by evidence previously submitted.

Consequently, this court permitted the parties to present evidence on January 8 and 9, and on March 27, 1981, concerning these two issues. The Authority presented testimony by Robert B. Roth, President of Oliver B. Cannon & Son, Inc. (Cannon), the painting contractor which had performed both remedial and maintenance painting on the bridge over a period of years since 1971. The Authority also presented Herbert M. Mandel, Senior Vice President of Parsons, Brinckerhoff, Quade & Douglas (Parsons), the engineers who designed the bridge and supervised all phases of its construction including remedial painting. Bethlehem presented only one witness, Valentino J. Assetto, whose testimony consisted of an analysis of Cannon's 1971 daily reports. From this analysis he calculated the allocation of the Authority's remedial costs between blasting and painting. At the conclusion of the Assetto testimony, the Authority read into the record a transcript of the deposition of Herbert Holland, a retired Cannon employee who served as superintendent at the bridge site in 1971 and who was responsible for signing the Cannon daily reports for payroll purposes that year.

The parties asked permission to file memoranda of fact and law. Permission was granted and such memoranda were filed May 1, 1981.

Mr. Roth presented testimony regarding the cost of maintenance painting and surface preparation during the twelve-year period.[3] The single witness for Bethlehem presented no such testimony. Mr. Roth also presented testimony concerning the allocation of costs between the blasting and painting operation during the remedial period 1971 through 1977, with the exclusion of 1974, since no remedial painting was done that year. Mr. Roth allocated 46.3% of the cost of materials to the blasting operation, 80% of labor costs, 80% of the cost of insurance, security bonds and taxes, and 71.59% of the equipment rental costs to sand blasting. In summary, the contention of the Authority is that 65% of all payments to Cannon are attributable to blasting and 35% to painting.

Mr. Mandel on behalf of Parsons allocated 60% of the remedial supervisory engineering costs to the sand blasting operation. These figures result in the following recapitulation based on the Authority's testimony:

Net Payments to Cannon	$5,059,467.43
65% of Costs Attributable to Blasting	3,288,653.80
35% of Costs Attributable to Painting	1,770,813.61
60% of Payment to MDC for Grit in 1977	34,792.91
60% of Remedial Supervisory Fees to Parsons	224,976.35

Mr. Roth further testified that on the basis of actual experience with maintenance repainting during the years 1978 and 1979, the cost for normal surface preparation over a period of twelve years, including sand blasting, would be $285,576.03.

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[3] This period was found by the court to be the normal life of the three-coat epoxy paint specified in Section 7 of the contract between the parties. See p. 34 of the trial justice's decision filed March 15, 1979.

Mr. Assetto's analysis would give rise to a different allocation of costs, namely 27.97% attributable to blasting and the remainder attributable to application of paint to which should be added maintenance cleaning costs of $311,537,69. This would result in a credit to Bethlehem in the amount of $1,066,931.27. The difficulty with the Assetto analysis is that it is based upon a series of daily reports which were simply not generated in order to determine such an allocation of costs as is now being required of this court. As a consequence, while Mr. Assetto's analysis is interesting, it has no factual basis in the evidence save casual notations about blasting which, according to Mr. Holland, were not designed to reflect any such allocation. Indeed, Mr. Holland stated in his deposition that the blasting time on the bridge amounted to between 75% and 80% of the total remedial time expended. Thus, Mr. Assetto's analysis was based upon assumptions which have been rejected by the person who was responsible for authenticating the daily reports. Bethlehem's conclusions concerning maintenance painting costs is not based upon testimony offered by its witness, but simply an application of its own escalation factor to testimony given by Mr. Roth. Therefore, in the opinion of the court, the Authority's evidence is more solidly based upon fact and expert opinion and must form the predicate for the findings of fact.

Consequently, the court finds the following facts:

(1) The allocation of cost of sand blasting is equal to 65% of the total net payments to Cannon.

(2) The allocation of cost of painting amounts to 35% of net payments to Cannon.

(3) The amount of blasting costs which in the ordinary course of events would have been incurred in normal maintenance painting totals $285,576.03.

(4) To the cost of sand blasting should be added 60% of the MDC payments for grit for 1977.

(5) To the cost of sand blasting should be added 60% of the remedial supervision fees to Parsons.

(6) Bethlehem is entitled to a credit of 25% of the sum of painting costs, plus maintenance blasting costs.

To recapitulate the arithmetical conclusions from these findings, the following figures will form the basis for a judgment:

Net Payments to Cannon	$5,059,467.43	
Blasting Costs at 65%	3,288,653.82	
Cost of Application of Paint at 35%	1,770,813.61	
Normal Maintenance Cleaning and Blasting Costs	285,576.03	
Computation of Bethlehem Credit		
Painting Costs		$1,770,813.61
Normal Maintenance Cleaning and Blasting Costs		285,576.03
Total Painting and Normal Maintenance and Blasting Costs		$2,056,389.64
Credit to Bethlehem at 25% of Total Painting and Normal Maintenance Cleaning and Blasting Costs (See Prior Revised Decision)		$ 514,097.41
Net Payments to Cannon	$5,059,467.43	
Subtract Credit to Bethlehem	– 514,097.41	
	$4,545,370.02	
Add 60% of MDC Payments for Grit for 1977	34,792.91	
Add 75% of remaining 40% of MDC Payments	17,396.45	
60% of Supervisory Fee to Parsons	224,976.35	
Add 75% of remaining 40% of PBQ&D Payments	112,488.17	
Total Principal Sum due to Authority Prior to Computation of Interest and Prior to Crediting Counterclaim of Bethlehem	$4,935,023.90	

From the resultant figure, Bethlehem is entitled to deduct the amount of its counterclaim in the sum of $804,996.55 together with interest thereon at the statutory rate.

The Authority is also entitled to add to its net judgment interest at the statutory rate after exhaustion of the counterclaim credit. In view of the fact that the Legislature has recently amended G.L. 1956 (1969 Reenactment) § 9-21-10 to provide for interest at the rate of 12% per annum in all civil actions from the time of the accrual of said action, it will be necessary to recalculate interest on the counterclaim due to Bethlehem and the principal sum due to the Authority at this amended rate.

The court hereby directs the parties to calculate the interest due on Bethlehem's counterclaim from the date upon which it should have been paid under the terms of the contract, and the interest due to the Authority on that incremental amount of all payments made for remedial painting and blasting which is attributable to the principal sum due to the Authority. Upon completion of these calculations, the parties may prepare a final judgment for entry by the court.

II (B)

Judgment of Superior Court After Second Remand Entered September 2, 1981.

State of Rhode Island Superior Court
Newport, Sc.

Rhode Island Turnpike and Bridge Authority Plaintiff	)	
-vs-	)	
Bethlehem Steel Corporation and Insurance Company of North America Defendants	)	C.A. File #70-237
-vs-	)	(Moved permanently to Providence County)
Walter S. Douglas, et al. Counterclaim Defendants	)	

Judgment After Second Remand.

The above-entitled case came on for a second hearing on remand before this Court commencing on January 8, 1981 and was further heard on January 9 and March 27, 1981, at which time the hearing was closed. These hearings were necessitated by the opinion of the Rhode Island Supreme Court filed June 10, 1980 (See ____ RI ____, 415 A2d 1295 (1980)) in which an appeal of the plaintiff had been sustained and appeals of the defendants had been denied.

For clarity and travel of the case, reference is made to the following:

A) The Decision of the Trial Justice filed December 31, 1975.

B) The Revised Judgment of January 30, 1976.

C) The Opinion of the Supreme Court dated August 11, 1977 and reported in ____ RI ____, 379 A.2d 344 (1977).

D) The Revised Decision of the Trial Justice dated March 15, 1979.

E) The Judgment after Remand dated April 6, 1979.

F) The Opinion of the Supreme Court dated June 10, 1980 and reported in ___ RI ___, 415 A2d 1295 (1980).

G) The revised Decision of the Trial Justice on the Second Remand Hearing dated June 26, 1981.

H) The Supplemental Decision of the Trial Justice dated August 21, 1981 relating to the computation of interest.

Based upon all of the foregoing this Court does hereby render the following Judgment:

1) The Authority is entitled to recover on its principal complaint the sum of $4,935,023.71 for remedial painting costs incurred as a result of faulty preparation of the surface of the steel and faulty application of paint coatings on the various structural members of the Newport Bridge as erected by defendant Bethlehem, which sum is the total proven remedial costs calculated as follows and then prorated as follows:

Contractor	Proven Costs	Concessions	Net
		$19,741.84)	
O. B. Cannon	$5,141,861.35	62,652.08)	$5,059,467.43
P.B.Q.&D.	374,960.59	0.00	374,960.59
M.D.C.	57,988.18	0.00	57,988.18
	$5,574,810.12	$82,393.92	$5,492,416.20

(See page 37 of Revised Decision of March 15, 1979)

Bethlehem Credits:

O.B. Cannon	.101611% of $5,059,467.43	=	$514,097.52
P.B.Q.&D.	.10% of $374,960.59	=	37,496.10
M.D.C.	.10% of $57,988.18	=	5,798.87
			$557,392.49
			557,392.49
			$4,935,023.71

2) Defendant Bethlehem is entitled to recover on the first count of its counterclaim the balance of the contract price in the sum of $804,996.55, together with interest thereon at the rate of 12% per annum, in the full amount of $80,215.71, which would be credited against the sum to which the Authority should be entitled under Paragraph 1 hereof.

3) Defendant Bethlehem is entitled to recover nothing under Count II of its counterclaim and said Count II of the counterclaim is denied and dismissed as against the Authority and Parsons.

4) Defendant Bethlehem is entitled to recover nothing under Count III of its counterclaim and said Count III of the counterclaim is denied and dismissed as against the Authority.

5) The Authority is entitled to recover interest at the rate of 12% per annum as follows:

i) Upon 89.8389% of the amount paid to Oliver B. Cannon & Sons, Inc. for remedial painting;

ii) Upon 90% of the amount paid to Parsons, Brinckerhoff, Quade & Douglas for engineering supervision of remedial painting; and

iii) Upon 90% of the amount paid to M.D.C. Industries, Inc. for blasting grit used in the remedial painting.

over and above the credit due to Bethlehem on Count I of its counterclaim. Under this arithmetical computation, as agreed by the parties, the plaintiff Authority is entitled to the sum of $2,928,007.69 in interest to be added to the principal sum set forth in Paragraph 1 of this Judgment as of June 30, 1981.

6) Judgment is hereby rendered in favor of the plaintiff Authority against defendants Bethlehem and I.N.A. in the total sum of $6,977,819.14.

7) Judgment is rendered in favor of counterclaim defendant Parsons for its costs.

8) The findings of fact and the conclusions of law which have been made by this Court are set forth in a number of written decisions filed December 31, 1975; March 15, 1979; June 26, 1981 (originally filed June 10, 1981); and August 21, 1981 and therefore will not be repeated in this Judgment document.

9) All interest calculations reflected in this Judgment were made to June 30, 1981. This Judgment therefore shall bear interest at 12% per annum from that date to the date of satisfaction.

ENTERED as the Judgment of this Honorable Court on the 2nd day of September, A. D. 1981, effective as of June 30, 1981.

O. WRIGHT
Deputy Clerk

ENTER:
WEISBERGER, J.
9/2/81
as of 6/30/81
Appeal period dates from 9/2/81,
the date of actual entry of judgment.
WEISBERGER, J.
9/2/81

II (C)

Supplemental Decision of Superior Court (Filed August 21, 1981) Relating to Computation of Interest.

State of Rhode Island and
Providence Plantations

Newport, Sc. Superior Court

Rhode Island Turnpike and Bridge Authority	)	
	)	Civil Action
v.	)	File No. 70-237
	)	(Transferred to
Bethlehem Steel Corporation and Insurance Company of North America	)	Providence County)

Second Remand

Supplemental Decision Relating To Computation of Interest

WEISBERGER, J. After a revised decision was filed following a second remand hearing concerning the principal amount due to the Rhode Island Turnpike and Bridge Authority on its complaint and the amount due to Bethlehem Steel Corporation on its counterclaim, the parties requested permission to file memoranda concerning the effect of the amendment to G.L. 1956 (1969 Reenactment) § 9-21-10 which provides for interest in civil actions as follows:

> "In any civil action in which a verdict is rendered or a decision made for pecuniary damages, there shall be added by the Clerk of the Court to the amount of damages interest at the rate of twelve per cent (12%) per annum thereon, from the date the cause of action accrued, which shall be included in the judgment entered therein."[1]

Permission was granted by the court and the parties duly filed memoranda in support of their respective positions. The

[1] This statute was amended by P.L. 1981, ch. 54 to increase the amount of the rate of interest from 8% to 12%. This amendment became effective May 8, 1981.

plaintiff argues that the new rate of interest should be applicable to all amounts due upon which both the Authority and Bethlehem are entitled to recover on the complaint and counterclaim respectively from and after the date of accrual of said claims. The defendant argues that 8% interest should be applicable up to the effective date of the recent amendment to § 9-21-10, and that the 12% rate of interest should apply thereafter. In the opinion of the court the plaintiff's argument is supported by dispositive authority.

The identical question was considered by the Supreme Court of Rhode Island in *Foster v. Quigley*, 94 R.I. 217, 179 A.2d 494 (1962). In that case the plaintiff commenced his action on May 1, 1951. Thereafter, the predecessor to the instant statute which provided for interest in certain causes of action became effective on September 1, 1958. Even though the commencement of the action preceded the effective date of the statute, its terms were held to be applicable in accordance with the provisions of the statute from and after the commencement of the action. Chief Justice Condon observed:

> "Interest on a judgment * * * is not of the substance of the right of action but exclusively an incident attached thereto by legislative fiat after such right has been adjudicated. The period for computation of such interest is in the same category. It is in essence analogous to costs concerning which it is said that 'a statute establishing costs and fixing court fees applies to pending cases equally with those arising after its enactment, unless a contrary purpose is expressed or fairly inferable from the words used' * * *.
>
> "In consonance with this view it has been held by respectable authority that interest on a judgment is ordinarily computed in accordance with the statute in effect at the time of its rendition rather than at the time the action accrued * * *. Consistently with such view it has

> also been held that an incident thus attached by legislative fiat to a judgment could be changed at any time." *Id.* at 218-19, 179 A.2d at 495.

The court went on to construe the statute as intended to become operative in any case where a decision is made or verdict rendered after its enactment, irrespective of the time when the action was commenced.[2]

One year later in *Kastal v. Hickory House, Inc.*, 95 R.I. 366, 187 A.2d 262 (1963), the Supreme Court of Rhode Island, again dealing with the predecessor of the present § 9-21-10, stated that this statute was

> "* * * so clear and unambiguous there is no room for the application of the usual canons of statutory construction. In such a case the statute declares itself." *Id.* at 369, 187 A.2d at 264.

The statute in its present form states that the interest rate of 12% shall be added "from the date the cause of action accrued." As in *Kastal, supra*, this statute leaves no room for interpretation. The defendants' arguments concerning constitutional limitations upon the right of a Legislature to provide for interest in respect to pending claims have been effectively rebutted in *Funkhouser, et al. v. Preston Co., Inc.*, 290 U.S. 163, 54 S. Ct. 134, 78 L. Ed. 243 (1933). In essence the Legislature is providing as an incident to the right of a plaintiff to compensation an increment of interest as a recompense for the delay incurred in coming into possession and enjoyment of sums due to which the party is determined to be entitled. In the present context of money markets, it can scarcely be said that a 12% rate of interest is unreasonable.

[2] This interpretation has been followed and applied by Judge Day of the United States District Court in *Holmes v. Bateson*, 434 F. Supp. 1369 (D. R.I. 1977), *aff'd.* 583 F.2d 542 (1st Cir. 1978), and *Oresman v. G.D. Searle & Co.*, 388 F. Supp. 1175 (D. R.I. 1975). Both cases involved a retroactive application of interest as in the case at bar.

For the reasons stated, the parties may present to the court a form of judgment which will provide for interest at the rate of 12% upon amounts due and owing to the plaintiff from and after the accrual thereof, and reduced by the amount of the counterclaim, together with interest thereon from the date of accrual thereof at the rate of 12%.

These calculations will result in a net judgment in favor of the plaintiff Authority against defendants Bethlehem Steel Corporation and Insurance Company of North America in the total sum of $6,978,246.07 as of June 30, 1981. From and after that date the judgment as entered will bear interest at 12% per annum to the date of payment, in accordance with G.L. 1956 (1969 Reenactment) § 9-21-8 and § 6-26-1, as amended by P.L. 1981, ch. 5, § 2.

III (A)

Revised Decision of Superior Court After Remand,
Filed March 15, 1979.

STATE OF RHODE ISLAND AND
PROVIDENCE PLANTATIONS

NEWPORT, SC. SUPERIOR COURT

RHODE ISLAND TURNPIKE AND)
BRIDGE AUTHORITY)

-vs-) Civil Action
File No. 70-237

BETHLEHEM STEEL CORPORATION)
and INSURANCE COMPANY)
OF NORTH AMERICA)

REVISED DECISION.

WEISBERGER, J. This case comes before the Court on directions of remand from the Superior Court wherein the trial justice[1] was instructed to reconsider certain items in the light of questions raised on appeal. The parties have agreed that of the six issues which were remanded, only one remains to be determined. This issue relates to the credit to which Bethlehem Steel Corporation (Bethlehem) should be entitled for such benefit as its paint job bestowed upon the Rhode Island Turnpike and Bridge Authority (Authority) against the total cost of the remedial painting required by the massive paint failure which this Court has already found as a matter of fact to have been caused by the defendant's faulty preparation of the steel surface of the Newport Bridge.

The issue may best be posed in the language used by the Supreme Court itself, which is set forth as follows:

> "... The Authority contracted for a paint job estimated to last up to 15 years, but as a result of Bethlehem's breach, the work fell far short of that expectation. Therefore, some allowance for future costs is proper.

[1] The trial justice is no longer a member of the Superior Court, but jurisdiction to complete this case on remand is retained pursuant to the provisions of G.L. 1956 (1969 Reenactment) § 8-2-26.

"On the other hand, the Authority has received some benefit from Bethlehem's work; the paint has lasted a few years, the duration varying in different sections of the bridge. Accordingly, Bethlehem must receive some credit for the benefit bestowed. Cannon's costs should be prorated over the expected life of the remedial paint job, and Bethlehem should be charged only that portion allocable to the shortfall of its own work. See *525 Main Street Corp.* v. *Eagle Roofing Co.*, 34 N.J. 251, 168 A.2d 33 (1961).[13]

"Because the trial justice did not make findings as to the expected life of Bethlehem's or Cannon's work under the Section 7 Specifications, we remand the case for further findings and assessments of damages in accordance with this rule." *Rhode Island Turnpike and Bridge Authority* v. *Bethlehem Steel Corporation*, ____ R.I. ____, 379 A.2d 344, 358 (1977).

The foregoing issue relating to the benefit bestowed upon the Authority was never litigated before this Court in the original trial. Testimony concerning the anticipated life of the paint job for which the Authority bargained was offered only in respect to the issue of liability. Therefore, it lacked the precision necessary to determine the question of shortfall as that issue was posed in the Supreme Court opinion. Also, the date upon which the benefit bestowed ceased to be operative was not considered or presented in evidence at the original trial with any degree of precision. Therefore, this Court determined that it was necessary to hold hearings and determine facts before the Supreme Court's mandate could be appropriately implemented. To this end, hearings were held on eleven separate days, during the months of June, August and

[13] Thus, if Bethlehem's work should have lasted 10 years, but repainting was necessary after 2, Bethlehem can be charged only 80% of the remedial cost."

September 1978. Thereafter, the parties were permitted to file memoranda of fact and law, and subsequently, oral argument was set for December 18, 1978.

The determination of this remaining controversy requires certain specific facts to be found:

1. The total cost of remedial painting, which has now been completed;

2. The probable length of the life of the two-component epoxy paint system set forth in Section 7 of the specifications relating to the bridge coating;

3. The period during which the Bethlehem paint job could be found as having bestowed some benefit upon the Newport Bridge.

In order to place these matters in appropriate context, some review of the testimony on these issues will be set forth below.

SUMMARY OF TESTIMONY

The first witness, Mr. Bernhard Buschbom, presented a moving picture film which had been introduced as Plaintiff's Exhibit 11 in the original case. He accompanied this film with commentary concerning subsequent inspections and completing of remedial painting, as well as the current condition of the various segments of the repainted bridge.

The next witness was Herbert Mandel, Senior Vice President of Parsons, Brinckerhoff, Quade & Douglas (Parsons), which had served as the engineering firm which designed and supervised the building of the bridge structure. Mr. Mandel served as Project Manager for the Newport Bridge from 1963 to 1970. He stated in substance that when he inspected the bridge in 1970, he found that failure of the paint covering was widespread. He noted flaking and peeling paint, uncovered areas, and also areas where the paint could be peeled off by hand. He noted at this point that repainting was necessary for certain sections of the bridge.

He stated that he left Newport for Honolulu in July of 1970 and returned to Newport in June of 1971. At that time he observed that remedial painting of the suspended spans was underway. Where remedial painting had not yet taken place, deterioration had continued. Mr. Mandel again returned to Honolulu and did not visit Newport until 1974 when he became once more the officer in charge of the Newport Bridge project, a responsibility which he still retains. He inspected the bridge in the spring of 1977 and noted that the remedial paint work which had been done in 1971 was in excellent condition except for a few spots which constituted an infinitesimal fraction of one per cent. Mr. Mandel admitted that he was not a paint expert, but stated that any uncoated steel requires cleaning and repainting. If steel is not protected and the condition is allowed to continue, a danger will be posed to the integrity of the structure. He admitted on cross-examination that at no point did the loss of section of the Newport Bridge steel structure endanger the margin of safety which had been built into the structure, but stated that immediate cleaning and painting was required.

The next witness, Edward P. Scheetz, had been employed by Oliver B. Cannon, Inc. (Cannon), the firm which had carried out all of the remedial painting on the Newport Bridge. Mr. Scheetz currently serves as the New England Area Superintendent of Cannon. He stated that he worked for Cannon for twenty-three years, that his duties included production, safety, and quality control on each job performed in the New England area. He stated that he first visited the Newport Bridge in 1971. At first he anticipated cleaning the structure prior to repainting by a spot blasting technique. He then expected to apply three coats of paint to the areas which had been spot blasted. He started to implement this technique for about one and a half months to two months, but found that it was more efficient to blast off all of the existing

paint coating and to abandon the spot blasting technique. It was also intended to blast clean to an SSPC 6 commercial level of cleanliness. However, in some areas where there had been severe pitting, it was necessary in order to rid the steel of corrosion that the blast level would go beyond the SSPC 6 in respect to the pitted areas and those areas adjacent thereto. Usually during the year 1971 painting season, the Cannon employees would spend about eight hours blasting for every two hours of application of paint. In 1972 and '73, Mr. Scheetz became Project Manager for the Newport Bridge painting project and was at the bridge site all the time. In 1974 there was no painting done. In 1977 and '78, Edward Pacheco was Project Superintendent. When Mr. Scheetz inspected the bridge in 1971 the paint was literally "coming off in the breeze." He found it to be in such a mess that he had never seen anything comparable before. During all of the seasons in which remedial painting took place, the ratio of blasting to painting was approximately eight hours of blast to one and one half hours of paint application. He stated that the work done by Cannon employees in 1971 was still in good condition as disclosed in an inspection just prior to the date of his testimony. He stated that the 1972 repainting job also remains in good condition.

Mr. Scheetz further stated that if one were to apply a new coat of epoxy paint over reasonably sound paint which had been previously applied, it would take about twelve to fourteen per cent of the total time of application for blast cleaning. However, on the Newport job, it took about eighty per cent of time in blasting and twenty per cent in paint application. The witness testified that he had had twenty-eight years of field experience doing maintenance painting on more than one hundred jobs, which included chemical plants and paper manufacturing facilities. Some of these jobs involved epoxy paint, but not necessarily all were the same as the Section 7

type used on the Newport job. He regarded all epoxy paint coatings as being similar.

The next witness was Walter S. Douglas, a partner in the Parsons firm. He stated that he inspected the bridge in May of 1970 and saw many areas where the paint had flaked off and was bubbling and peeling. At this time he believed as a result of his inspection that repainting would be necessary and that about fifty per cent of the area would require sand blast cleaning. He was continually involved with the Newport project until his retirement approximately one year prior to the remand hearing. Mr. Douglas described the benefit bestowed by the Bethlehem paint job in the following terms:

When the blasting began in 1971, it became apparent that the rust and corrosion had proceeded so extensively beneath the paint that all of the paint covering had to be removed from the affected areas. Since the benefit of any paint is to prevent rusting of the steel, there was no benefit bestowed upon the bridge structure by this paint from the year 1971. He stated that it is impossible to determine how much benefit was given to the structure by this paint covering between 1968 and 1971. It was his opinion that from the time in 1971 that the engineers and paint experts determined that none of the paint could be salvaged, no further benefit was bestowed upon any of the litigated portions of the bridge, whether remedial painting took place that year or thereafter. On cross-examination, Mr. Douglas asserted that any benefit from the Bethlehem paint job had ended before the date of beginning the remedial painting in 1971, but could not say how much before this period the benefit had ended. He summarized his opinion by stating that the benefit of the Bethlehem paint job lasted a maximum of three years. The parties stipulated that the average date of application of the Bethlehem paint job was July 1, 1968.

The next witness was Robert B. Roth, the President and chief officer of Cannon. He stated that the costs incurred for remedial painting were necessary and reasonable, and that all of the costs were incurred in remedial as opposed to ordinary maintenance painting. Through Mr. Roth was presented Plaintiff's Remand Exhibit 3, which consisted of copies of requisitions and a review of the Cannon payments made during the years 1971, '72, '73, '76 and '77.

Mr. Roth testified that the Section 7 two-component, three-coat epoxy paint system should have had an expected life before a major recoating was necessary of between twelve and fourteen years if properly applied. He stated that the Cannon remedial paint job, based on his inspections and on other projects, should have a life somewhat in excess of fifteen years before a major recoating is necessary. He stated that such an epoxy coating with touch-up maintenance carried out from time to time should never require a blast cleaning of the entire bridge down to metal before recoating. With such a touch-up program it would be necessary only to put on a fresh coat of paint every twelve to fourteen years. He stated that the Authority should never again be required to undertake a blast cleaning program of the kind done in the period from 1971 to 1977. He stated that on the basis of his experience with the Newport Bridge, the Bethlehem paint job was not performing the function of protecting the steel by December 1970.

He stated that the amount of time which was spent in blasting was four or four and a half to one in relation to the time spent painting. In ordinary maintenance painting or touch-up the relationship between blasting and painting would be about one hour of blasting to seven or eight hours of painting. Ordinary maintenance painting would not require the same scaffolding and stability of platforms as would be required in a remedial paint job such as that performed on the Newport

Bridge where sixteen air compressors were used. This pressure calls for a stable platform which would require four times as much scaffolding as would be needed for ordinary maintenance painting. He stated on cross-examination that one must express the probable useful life of a paint job in terms of a range rather than in terms of a specific time.

The next witness was Dr. James Scott Long, who has an eminent academic and practical background in epoxy paint coatings and who had testified at the original trial.[2] Dr. Long testified that the Section 7 epoxy paint system should have had a useful life of twelve to fourteen years, if properly applied, before a major recoating should have been required. He inspected the bridge shortly before the hearing and stated that the future life of the Cannon remedial painting with normal maintenance would be twelve years. He stated that the Bethlehem paint job had become worse than no covering at all by the spring of 1971. He stated that by this time it was bestowing no benefit. In fact, he stated, "I think it was the other way."

Dr. Long stated on cross-examination that it was appropriate to remove all of the faulty paint from the deteriorating areas. He felt it would not be prudent to expend money on a faulty foundation. He stated that the prospective life of a paint system must be expressed in a range; it cannot be pinpointed to a specific number of years.

The next witness was Dean Mosier Berger, who was employed by Gilbert Associates, an engineering firm with offices in Reading, Pennsylvania. He was a graduate of North Central College with a Bachelor of Science Degree in chemistry in 1944. He took postgraduate extension courses at the University of Wisconsin in 1949 and spent two years in the naval

[2] Dr. Long's extensive credentials are set forth in detail in the transcript of the original hearing and are referred to in this Court's prior decision at pages 150 to 151.

service. He has always been employed in the paint industry, specializing in coatings research until 1966. In that year he became a member of the Union Carbide Research Division. He stayed in that employment until 1974, when he became associtated with the Gilbert Engineering firm. He is a member of a number of professional societies, including the Steel Structures Painting Council and the National Association of Corrosion Engineers. He introduced a resume' and bibliography of published articles, which was marked as Plaintiff's Remand Exhibit No. 5.

Mr. Berger became associated with the Newport Bridge project in May of 1978. He examined the Section 7 Specifications of the Newport Bridge contract and estimated that its expected life prior to a major recoating should have been in the range of twelve to fifteen years in the marine environment of the Rhode Island seashore. He inspected the Newport Bridge on May 16, 1978 and most recently on June 19, 1978. He found the Cannon remedial paint in good condition in all areas. He outlined certain major philosophies concerning rust control and paint maintenance. He stated that a touch-up program was appropriate as soon as rust was detected. When paint is reduced to a condition described as 5 on a scale of 10, then it should be totally removed.

The next witness was Ignatius Metil, a Doctor of Science from Buffalo, New York. He received his Doctorate of Science form Graz Institute of Technology in Austria. He had also received a Master of Arts Degree at Canisius College in the field of chemistry in 1961. Upon his arrival in the United States, Dr. Metil worked in the Bethlehem laboratory until 1954. He then worked from 1954 to 1957 in the Nukem Laboratory in Buffalo. He served as lab manager from 1957 until 1969 when the company was acquired by Amercoat. He then worked for Hempel's Marine Paints, Inc. He is a member of the National Association of Corrosion Engineers and other

professional societies. He holds patents in the fields of epoxy coatings and has published articles in various trade journals. He was contacted in mid May of 1978 for the purpose of requesting that he inspect the Newport Bridge. He did so on May 19, 1978. He also examined a copy of the Section 7 Specifications and found that the expected life of this system should be from twelve to fifteen years.

On May 19, 1978, he walked the entire length of the Newport Bridge, and on June 19 again inspected the structure. He stated that with touch-up maintenance, the Cannon remedial paint which he observed should last approximately fifteen years. He stated that by April of 1971, on the basis of information supplied to him, the Bethlehem paint job was conferring no benefit at all on the steel structure of the bridge. He asserted that it required more work to remove the paint and the rust. Therefore, the coating served no beneficial purpose, but only created an additional burden.

The next witness was Frank Libonati, who was employed by Cannon in its Philadelphia office as Controller. He authenticated various exhibits which were introduced into evidence relating to equipment rental costs incurred in respect of the Newport Bridge.

The next witness, Edward Pacheco, who had served as job superintendent for the Newport Bridge for the Cannon firm, also testified concerning materials cost allocation for paint and sand.

At this point Mr. Robert B. Roth was returned to the stand for cross-examination and discussed some of the details of the remedial painting.

Thereafter, Mr. Edward Pacheco was returned to the stand and made certain corrections in the initial cost allocations contained in Plaintiff's Remand Exhibits 8, 9, 10, 11 and 12 for identification.

Mr. Libonati resumed the stand and testified as to further changes in calculations based upon the Pacheco changes in allocation of equipment.

Mr. Edward P. Scheetz then returned as a witness and testified that he reexamined Plaintiff's Remand Exhibit 7 along with Mr. Frank Libonati and made certain changes based upon his recollection and experience, whereupon a new document had been prepared relating to equipment rental cost allocation for the 1971 season. This was offered and marked as Plaintiff's Remand Exhibit 7-A for identification.

Mr. Libonati then took the stand and said that he had gone over each invoice with Mr. Scheetz, revised certain allocations, and from these revised invoices Plaintiff's Exhibit 7-A for identification was prepared to reflect these allocations. Thereupon, revised exhibits as to cost allocation of equipment rental and material costs for the years 1972, '73, '75, '76 and '77 were introduced as Plaintiff's Remand Exhibits 8-A through 14-A.

However, on cross-examination, defendant's counsel pointed out a $16,000 error on paint for the 1977 season which was admitted to be maintenance rather than remedial paint, since it was a zinc rich application.

Mr. Herbert M. Mandel then resumed the stand in order to authenticate expenditures for engineering costs for the years 1971, '72, '73, '75, '76 and '77 totalling $374,960.59. These services were limited only to remedial painting, and were necessary, fair and reasonable for the years in question. It was noted that this Court had already found engineering expenses as necessary and reasonable for the years 1971, '72 and '73.

Edward Pacheco then resumed the stand and reviewed Plaintiff's Remand Exhibit 14-A for identification for all years except 1971, and testified that the only error in this exhibit was one in the sum of $16,695 wherein zinc rich paint

was erroneously included. He pointed out that in the years 1972, '73 and '75, no maintenance painting was being done.

On cross-examination, Mr. Pacheco admitted that certain grit used for blasting of the inside of the towers had been purchased for remedial painting purposes, although the blasting of the inside of the towers was a maintenance job. He pointed out that if this grit had not been used for this purpose it would have been thrown away.

Mr. Scheetz then resumed the stand and testified that he was in charge of preparing the 1971 portion of Plaintiff's Remand Exhibit 14-A. He stated that there was no maintenance painting done that year, and therefore, there was no error to be found in the summary for that year. At this point the Court indicated that Plaintiff's Remand Exhibit 14-A would be admitted as a full exhibit after calculations had been made to eliminate the erroneous items of $16,695.

Thereafter, Mr. Pacheco again testified concerning the blasting and painting operations during the years 1972 to 1977. He stated that for the years 1973, '75, '76 and '77 he served as Superintendent. He stated that when he first saw the bridge he could not believe the condition of the paint. He stated that the whole bridge needed repainting by June of 1972. He authenticated Plaintiff's Remand Exhibit 16, which dealt with the purchase of grit for the year 1977.

Mr. Pacheco stated that he performed the allocation of grit between remedial and maintenance painting. He designated loads to be marked "Remedial" and also loads to be marked "Maintenance." He stated that an employee named "Tom" did the marking. He stated that the grit was necessary in order to clean the steel.

The next witness was Marion J. Pierce, Chief Accountant for the Authority. This witness testified concerning amounts paid on requisitions for remedial and maintenance purchases of grit. She made the allocations in her records based upon markings contained on the shipping documents.

At this point the plaintiff rested and Bethlehem called a series of witnesses.

The first witness was Henry F. Boutin, who had been employed by Cannon as a sand blaster for a period of eight years. He testified concerning the details of the blasting and rigging which he had done during the years 1971 to '73.

The next witness was Edward Felix, also a Cannon employee, who worked on the Newport Bridge between 1976 and 1978.

The next witness was Anthony Medeiros, who was a Cannon employee for about ten years. He currently serves as a foreman and has been in the painting business for about seventeen years. Mr. Medeiros also worked for the Conomos firm, which applied paint for Bethlehem on the Newport Bridge. He testified that he worked on the bridge during the years 1972, '73, '75, '76 and '78. He testified concerning the painting which was done in each year and the part which he played.

The next witness was Victor Lombard, Jr., who currently works for Cannon as a foreman, in respect to blasting and painting work. He also worked for Conomos on the Newport Bridge during the Bethlehem paint job. He stated that he worked for Cannon since 1971, that most of his work was in blasting at the beginning on the suspended span. He also did rigging work. He also testified as to the details of the work which he performed.

The next witness was Joseph R. Manville, Jr., of Middletown, Rhode Island, who has also worked for Cannon since 1971, and previously worked for Conomos on the Newport Bridge. He stated that the blasting effort has not changed over the years. In 1971, the Cannon employees were instructed to take off all of the green paint and all of the rust, but to leave the red undercoat if it were "stubborn." He stated that cleaning around the bolts was more difficult than

cleaning the flat surface. He stated that they used plywood shields in order to keep from damaging adjacent paint.

The next witness was Roger Pinheiro of Newport, Rhode Island, who was a Cannon employee for six to seven years. He started work on the Newport Bridge in 1971. He worked as a blaster and also applied paint. He had worked for Conomos in 1969 in connection with the Bethlehem paint job on the Newport Bridge. He stated there were four men in his crew. At first they tried to experiment and keep as much paint as they could. It was later decided that they should take off all the paint except on the bolt plates, where they would try to leave good paint. He stated that on the connection plates, if one blasted the bolt heads, one would pick up the paint on the areas between the heads. He stated that there was no problem in "marrying" new prime coat paint to old prime paint. He stated further concerning the details of both maintenance and remedial painting.

The next witness was Dominic J. Calaro, who was a Cannon employee since 1971. His testimony was similar to that of the previous Cannon painters. He discussed the application of zinc rich paint on the towers as well as applying epoxy paint.

Edward Pacheco then resumed the stand again and testified that the painters were generally truthful in describing their operations.

The next witness was Woodrow Hunt, who had served as a Conomos Company foreman on the Newport Bridge from 1967 to 1970. Thereafter, he went to work for Cannon in 1971 as a painting foreman. He testified that he had supervised blast cleaning of the connection areas for Conomos to a near white condition. There had been no paint on the connection plates, and therefore they had rusted. It was necessary to blast from four different angles. He stated that zinc rich primer had been used in these areas. Mr. Hunt testified that in 1971 he again blast cleaned the connection areas to a near

white condition, although the paint on these areas had not yet failed. He pointed out that it was difficult to blast these areas, particularly the second time. He testified that blasting the connection areas would be twice as difficult as blasting the areas in between the connection areas.

On cross-examination, Mr. Hunt testified that he left Cannon's employ in 1976 for personal reasons after an argument with one of Cannon's estimators. He stated also on cross-examination that the Newport Bridge suffered the greatest paint failure he had ever seen, but this failure was not on the connection plates, but in between.

The next witness was Albert R. Tarola, who testified that he had been employed by Bethlehem for thirty-two years as an analyst. He had analyzed the surface structure of the steel portions of the Newport Bridge, eliminating the towers. He stated that the connection areas, including gusset plates, bolts and about six inches of adjacent areas, amounted to about twelve point nine per cent of the total surface area of the bridge.

The next witness was A. Robert Haas, who is a member of the firm of J. I. Haas Company, Painting Contractors, which has been in business since 1895. Mr. Haas had been in the painting business since 1926 and was a graduate of N.Y.U. with a Bachelor of Science Degree in 1925. He is presently the president of the company. Mr. Haas and his company have done all kinds of painting, including industrial and structural steel. In their structural steel department they employ one hundred or more persons. The total employment of the company varies to a point as high as three hundred depending on projects underway. He testified that repainting and blasting of the connection areas would be more difficult than the flat areas in between. He stated that he never saw a failure of paint such as was depicted on pictures contained in Plaintiff's Exhibit 126. He stated that his firm has never re-

moved a three-coat epoxy paint system under circumstances which prevailed in the Newport area.

The next witness was Charles W. Sisler, who worked for the Monsanto Chemical Company for twenty-seven years as an engineering executive. From 1951 to 1967 he served as a paint engineer. He prepared maintenance painting specifications. In 1964 he was given the entire plant "to play with." He had extensive practice as well as an academic background as a mechanical engineer. He stated that he had inspected the Newport Bridge the same morning on which he testified. He stated that the Section 7 epoxy paint should have a service life of not longer than six years. This opinion took into account the weather factor, which was not dissimilar to certain locations of some Monsanto plants in Texas. He stated that the service life could be extended by thickening the coats. For each mil of thickness, the service life should be extended approximately one year up to the point where the thickness would tend to cause cracking.

Mr. Sisler testified that cleaning the substrate of the steel to a near white degree would also extend the life of the paint, possibly by a year. He stated that he had heard Dr. Long's testimony. In effect he testified that the Cannon remedial paint, in some instances, had failed as significantly as had the original Bethlehem paint to varying degrees. He stated that the zinc rich paint on the gusset plates would have had a probable useful life of twelve to fourteen years. He stated on cross-examination that his six-year life span estimate was based on the assumption that there would be no maintenance at all in respect to the Section 7 epoxy paint. Mr. Sisler further expressed the opinion that paint applied by Cannon to the Newport Bridge in 1971 and '72 should be removed and entirely replaced.

The next witness was Charles G. Munger, of California, a graduate of Pomona College, who did further work at Clare-

mont College, but did not achieve his Master's Degree in the study of chemistry. He has been employed at the Amoco Concrete & Steel Pipe Company since 1935. He served in the accounting department for one year, then transferred to a research project on coatings. From that time forward he has been employed as a chemist. Later the company changed its name and Mr. Munger was placed in charge of all coatings, including epoxy and other high performance coatings. He worked for this company and its successor for thirty-nine years. He retired January 1, 1978. He has been a member of the Association of Corrosion Engineers from 1948 to the present. While serving as a member, he was also active with the Coatings Committee, of which he chaired one of the subcommittees. He served as President of the National Association of Corrosion Engineers in 1964.

Mr. Munger became involved with the Newport Bridge problem in May of 1978. He made two inspections of the bridge, one in June of 1978 and another on September 11, 1978. In June he examined the entire suspended span. He had been told that the east section of the suspended span was repainted in 1971. He found considerable corrosion in the interface between the connection plates and the steel girders. Corrosion was noted on the catwalk handrails. This was a typical marine corrosion with black oxide underneath.

He noted that the paint had apparently been well applied. Thickness ranged from eight to fifteen mils. He took about one hundred random readings and found the average to be about eleven or twelve mils in thickness.

He also examined areas of the bridge to which remedial paint had been applied in 1972. There he noted that corrosion was somewhat less advanced than in the 1971 area, but of the same general character. In this area the paint averaged about ten mils in thickness from approximately fifty to seventy-five readings.

The area to which remedial paint had been applied during the 1973 season was in much better condition. Some corrosion was noted on the edges, but much less than that which prevailed in the 1972 area. In this section, the witness took about twenty-five to fifty readings and found that the average thickness was about ten mils. He noted that in the east and west truss spans, the paint seemed to be in very good condition. He had been able to observe only from the catwalk. The east and west truss spans could only be perceived from a distance.

After discussing the subject of epoxy coatings in general, the witness stated that he had examined the Section 7 paint specifications and is of the opinion that such a coating would have a useful service life of five to seven years without any regular maintenance program. With a regular maintenance program, a useful service life would be extended to a period ranging from ten to fourteen years. This estimate is based upon the assumption that the paint would be applied to a degree of thickness as required by the specifications. Where paint was thicker, averaging nine point two mils, as found in the subject instance, the service life would be extended about three to four additional years. He stated that if the substrate to which the paint would be applied is cleaned to a degree of near white rather than SSPC 6 commercial level of cleanliness, the life would be extended further, to reach a range of from nine to fifteen years.

The witness stated that he had been responsible for the introduction of zinc rich primer into the United States from Australia, where this coating had been developed. He asserted that where connection areas were painted with a zinc rich primer covered by two epoxy coatings, with a total thickness of about fifteen mils, the life of such a paint application should have ranged from fifteen to twenty-one years without maintenance. This witness also stated on cross-examination

that he shared Mr. Sisler's opinion that the Cannon remedial paint applied in 1971 and '72 should now be removed and that it has reached the end of its useful life. He stated that as a general principle in the event that fifty per cent of the paint on a bridge is found to be defective, it becomes cost effective to remove all of the paint.

The next witness was John B. Conomos of Pittsburgh, Pennsylvania. Mr. Conomos was a principal officer of the Conomos Company, whose employees applied paint to portions of the Newport Bridge. The company was formerly headed by the witness's father. The Conomos Company has been in business for approximately eighty years. The father is now near retirement. The witness had attended the Carnegie Technical School of Industrial Management. He stated that his company has painted many structures, including bridges, and has applied many types of coatings, including epoxies. He stated that he had visited the Newport Bridge about three times per season from 1967 to 1970. At first his employees were instructed to use the three-coat epoxy with the same primer which had been applied at the shop. Later they changed to a zinc rich primer. The Conomos employees painted the connection areas in place. The cleaning of the connection areas was much more difficult to achieve, because of the presence of bolts, than the cleaning of flat areas. It was probably about three to six times as difficult to accomplish. He described the striping of the connection areas and cross hatching, both of which techniques resulted in the application of a thicker paint coating than had been specified. He stated that the removal of fifteen mils of paint from the connection plates would be more difficult than the removal of paint of the specified thickness.

Mr. Dean Berger was then recalled to the stand. He stated that he was familiar with both Charles Sisler and Charles G. Munger. He had inspected the bridge the morning of this

appearance in court, which took place September 12, 1978. He had examined the entire suspended span and looked toward the east and west truss areas. This inspection was designed to refresh his mind and to be sure that his previous perceptions were correct. He was aware that Messrs. Sisler and Munger had said that the 1971 and '72 paint areas should be redone at this time. He stated that he did not agree. He felt that spot repair would be acceptable. This would include blasting and repriming where needed at spots of corrosion. He stated that in the areas where remedial paint was applied in 1971 and '72 only fifteen to twenty steel members would need one hundred per cent reblasting and repainting. Eighty per cent of the rest of the structure would be susceptible of touchup applications. About twenty per cent of the steel members would not need any repair at all.

Mr. Berger stated that he had equipment which would allow spot blasting just in the affected areas. He stated that it would not be prudent to remove paint totally from sections which are intact, although he conceded on cross-examination that removal of sound paint is justified when the blaster cannot control the effect upon adjacent paint areas. He stated that controlled blasting has been practiced for a number of years. He states that in conventional commercial blasting, one cannot protect gusset plates without shrouding them at extra cost. Such shrouding would have to be by means of a metal protective plate or a plywood cover. He stated that the big commercial blasting units are quite different from the one-person units used for spot blasting. It takes two or three men to handle each of the big commercial units.

The next witness was Dr. Ignatius Metil. He stated that he had again visited the Newport Bridge on September 11, 1978. He was familiar with both Mr. Sisler and Mr. Munger. He also expressed the opinion that the areas to which remedial paint was applied in 1971 and 1972 were not in need of re-

blasting and repainting at this time. He stated that a maximum of about thirty per cent of the Newport Bridge needs correction as to its paint. Many of the steel members of the structure will not need any repair. Such areas as need repair could be corrected by the techniques recommended by Mr. Berger. He expressed the opinion that complete sand blasting would not be prudent.

Mr. Edward Pacheco was recalled to the stand and stated that he was familiar with the areas to which remedial paint had been applied in 1971 and 1972. He stated that it needed spot blasting by small portable units. Only a small amount of rigging would be needed. Only a minimum of equipment would be needed. Under such an arrangement a three-quarter inch nozzle could be concentrated on a spot. Thereafter, a prime coat could be brushed on the spot, the edges of the area feathered. Then the second and third coats could be applied. If there were a large number of spots in a particular beam, then the witness would recommend putting a top coat on the whole beam.

He said that the grit which was used on the towers consisted of no more than seven tons which had been left over from the remedial blasting work. Had this grit not been used on the towers, it would ordinarily have been thrown away. He stated that some cables were strung on the west stringer spans, which have been excluded from this litigation. This took about four days. He said that in order to apply a cosmetic coat of paint to the hand rails required one day for the north side. For this purpose they employed two sprayers, a mixer, Mr. Buschbom and Mr. Pacheco. They used seventy to eighty gallons of paint. When the south side of the handrail was done, they used two sprayers, a man in a truck and a foreman. In this job they spent three days and used about three hundred gallons of paint. He stated that the Cannon Company had no specific records showing the cost of performing the work on the hand rails and west stringer spans.

The next witness was Marion Pierce, who was in charge of the Authority's financial records. She stated that the last cosmetic application of paint on the Newport Bridge took place in May of 1977. She asserted that Mr. Pacheco was in error if he indicated that it was during 1976. She said that the Authority received a separate invoice of $14,077 for this job. This invoice covered maintenance cosmetic paint for the hand rail and the towers. She furnished detailed information as to the sums which made up this total amount.

The next witness was Edmond DiMeglio of Johnston, Rhode Island. He stated that he was a film maker and self-employed. He had been in the business for twenty-seven years and was employed by Channel 10 Television in charge of photography for a period of ten years. Thereafter he opened his own business. He takes motion pictures for all purposes, including litigation. In June of 1978, he was asked to take pictures of the underside of the Newport Bridge. In performing this function he was accompanied by Mr. Buschbom. In taking these pictures he used a standard sixteen millimeter film with a zoom lens. He carried the camera on his shoulder so he could walk with it. He started on the east end of the catwalk under the suspended span and proceeded to the west end of this span. The film was sent to Eastman Kodak for processing. They sent the original film on one reel plus a copy. He stated that the film fairly and accurately depicted what he saw on June 30, 1978. The film was allowed to be presented by the Court with comment furnished by Mr. Buschbom.

Mr. Buschbom stated that in filming an attempt was made to duplicate the earlier sequences and that the film fairly and accurately depicted what Mr. Buschbom saw on June 30, 1978. The Court noted in viewing the movies of the suspended span taken June 30, 1978 that they showed a few spots of rust and discoloration, but generally the paint appeared to be in good condition.

Findings of Fact and Conclusions of Law.

On the basis of the foregoing testimony, the Court must make reference to the remand order of the Supreme Court in order to determine the issues which are before it for determination. As mentioned at the beginning of this decision, the sole issue which remains for determination, by agreement of the parties, is the credit to be accorded to Bethlehem for such benefit as its paint bestowed upon the Newport Bridge and the allocation of that portion of remedial painting which is allocable to the shortfall of the Bethlehem work. Although the Court permitted the parties to range somewhat beyond this issue, upon assurances that testimony would be tied into the matter actually to be determined, in some instances this testimony was not relevant to the issue before the Court. To the extent that the relevance of such testimony to this issue was not established, the Court will disregard it.

Considering the evidence as a whole, the Court is of the opinion that the overwhelming preponderance of such evidence establishes the following facts:

1. The probable useful life of a properly-applied three-coat epoxy paint coating of the type set forth in Section 7 of the contract between the plaintiff and the defendant here would be twelve years.[3] In reaching this conclusion, the Court finds no evidence upon which to base an assumption that the Authority would not have carried out a reasonable maintenance program. Indeed, its activities since the remedial paint job has been completed would indicate that it is committed to

[3] Certain of defendant's expert witnesses had selected a shorter probable useful life for this paint system, but their credibility was diminished by their report of observations concerning the current condition of paint on the Newport Bridge. Their observations in this respect were directly contradicted by the photographic evidence presented, as well as by the testimony of plaintiff's witnesses.

a policy of normal maintenance. The fact that in earlier years all of the Authority's resources were committed to remedial painting was based upon exigent circumstances which would probably not have applied if the paint over the vast majority of the steel surfaces had not been subject to a massive and unanticipated failure.

2. The overwhelming preponderance of the evidence further indicates that no benefit was bestowed by the Bethlehem paint beyond a period of three years from and after its average initial date of application. Nearly all the credible witnesses were of the opinion that the Bethlehem paint job served no useful function subsequent to the spring of 1971. It is impossible to determine this period of benefit with mathematical precision. However, the Court is of the opinion that a determination of three years of benefit or one quarter of its anticipated useful life would do substantial justice between the parties. The case of *525 Main Street Corporation* v. *Eagle Roofing Co.*, 34 N.J. 251, 168 A.2d 33 (1961) is not disconsonant with this finding. In that case neither the Supreme Court of New Jersey nor the trial court purported to make the kind of determination which this Court makes in this case. It must be borne in mind that the trial judge in the *Eagle Roofing* case had made an award of only nominal damages. The Supreme Court of New Jersey instructed the trial court *at least* to award the portion of the contract price prorated for the balance of the five-year period. The Court does not feel that Bethlehem is entitled to a credit for any period after which the paint ceased to perform the function for which it was applied. The *Eagle Roofing Co.* case does not mandate or even suggest such a result.

3. The Court finds that by uncontradicted evidence, the Authority has shown the cost of remedial painting, including labor, supplies and engineering expenses. It should be noted, however, that on cross-examination, significant questions

were raised about seven items. The questions raised as to certain of these items were more substantial than the questions raised about others. For example, it was conceded that maintenance painting in the amount of $16,695 was improperly charged as a remedial painting cost. In its brief, the Authority conceded that this sum should give rise to a total reduction of $19,741.84. Further, at oral argument, the Authority conceded that as to the seven items which were questioned on cross-examination, the total cost amounted to $62,652.08. The Authority was willing to concede that this sum should be deducted from the total costs paid to the Cannon Company and also for the purchase of grit, since one of the items concerned the use of a quantity of grit for blasting the inside of the towers, which was not part of the remedial project. As a consequence, the Court will accept this concession and find specifically that the other elements of damages have been proven by the preponderance of the evidence, and indeed, are substantially uncontradicted. These items of expense and the deduction therefrom are set forth as follows:

Total amount allegedly paid to Cannon for remedial work	$5,141,861.35
Credit for maintenance paint work	19,741.84
Revised Total	$5,122,119.51
Amounts paid to Parsons for engineering service	374,960.59
Payments to MDC Industries, Inc. for purchase of blasting grit	57,988.18
Total claimed by plaintiff	$5,555,068.28
Deductible amounts conceded by Authority as nonremedial expenses	62,652.08
Proven remedial costs	$5,492,416.20

4. Since the Court has determined that the probable useful life of the paint application for which the Authority bargained

was twelve years and the actual benefit bestowed did not exceed three years, Bethlehem would be entitled to a credit of one fourth of the amount of the remedial painting costs in accordance with the formula expressed by the Supreme Court in its opinion, *Rhode Island Turnpike and Bridge Authority* v. *Bethlehem Steel Corporation*, ____ R.I. ____, 379 A.2d 344, 358 (1977). Applying this formula to the facts which the Court has found Bethlehem would be entitled to a credit or deduction amounting to $1,378,104.05. If this amount is deducted from the remedial painting costs as proven by the Authority, the net figure remaining as damages would amount to $4,119,312.15. This Court finds as a fact and holds as a matter of law that the defendant is liable to the plaintiff for this net figure.

5. In reaching its determination, this Court has not addressed the question of the propriety of removing paint and repainting the connection plate areas. This Court is of the opinion that this matter was not appropriate for consideration on remand. It was determined in the prior hearing that the Authority was justified in removing all of the paint from the affected areas, since it would be imprudent to attempt to preserve the small portion of the paint areas where the coating was intact. Although the Court permitted evidence to be adduced on this pont, it is of the opinion that nothing presented was of sufficient persuasive force to cause the Court to change the finding of fact which it previously made. The Court is aware that some of the areas of the bridge were painted after its initial determination. However, the Court is of the opinion that the repainting of the entire bridge was made necessary by the massive and unprecedented failure which was dealt with in the prior decision, and that the Authority's actions in replacing the entire coating on the litigated area were reasonable and necessary in light of the practical problems involved in the use of large commercial sand blasting equipment.

6. The Authority introduced extensive evidence and argued vigorously on the basis thereof that the additional cost of blasting should be deducted from any benefit found to be bestowed by the original Bethlehem paint coating. Although the Court concedes that enormous additional cost was encountered by virtue of the necessity of sand blasting almost the entire bridge structure in order to eliminate corrosion and pitting over vast areas, it feels that no deduction from the "benefit bestowed" is warranted on this score. The Court reaches this conclusion because it feels that the cost of blasting is reflected in the amounts paid for remedial painting and engineering services. Thus, deducting these additional costs from the credits to be applied for the period of useful life of the Bethlehem job would result in double compensation to the Authority.

7. In the prior decision of this Court, it was determined that the Authority was entitled to interest at the rate of six per cent per annum on the cost of remedial painting from the date when such payments were actually made. The judgment provided for credit against these payments and interest in the amount which the Authority owed to Bethlehem on its counterclaim in the principal sum of $804,996.55. The parties have agreed in accordance with the Supreme Court's opinion that Bethlehem is entitled to interest upon the amount of its counterclaim which represents the balance of the original contract price which has not yet been paid. Since the time of the original judgment, G.L. 1956 (1969 Reenactment) § 9-21-10 has been amended to provide for interest at the rate of eight per cent per annum in all civil actions for pecuniary damages from the date of the accrual of the cause of action. This Court would construe that section as providing for interest at the rate of eight per cent per annum on the principal amount due the Authority calculated from the dates when payments for remedial painting were actually made. The

statute would also entitle Bethlehem to interest at the rate of eight per cent on its counterclaim to be calculated from the date when such payment should actually have been made under the terms of the contract.

8. The Court will leave to the parties the calculation of interest on the sums due from the defendant to the plaintiff and also the sum due to Bethlehem under its counterclaim. When these sums have been calculated with interest, the amount due to Bethlehem should be deducted from the amount due to the Authority, and a net judgment figure, including interest, will then be determined. After the parties have made the necessary calculations in accordance with the guidelines expressed in this opinion, they may present to this Court a form of final judgment in conformity therewith. For convenience, it is suggested that the judgment be entered as of March 30, 1979, and that interest be calculated to and including that date.

In the event that the parties should be unable to resolve these questions of calculation, such disputes as may be incapable of resolution by agreement may be presented to this Court for determination.

III (E)

Judgment of Superior Court After Remand Entered April 6, 1979.

STATE OF RHODE ISLAND SUPERIOR COURT
NEWPORT, SC.

RHODE ISLAND TURNPIKE AND BRIDGE AUTHORITY	)	
Plaintiff	)	
-vs-	)	Civil Action
BETHLEHEM STEEL CORPORATION and INSURANCE COMPANY OF NORTH AMERICA	)	File No. 70-237
Defendants	)	
-vs-	)	
WALTER S. DOUGLAS, et al	)	
Counterclaim Defendants	)	

Judgment After Remand.

The above-entitled case came on for hearing before this Court commencing in June of 1979 and continued in August and September 1979 upon the Remand Issues set forth in the Opinion of the Rhode Island Supreme Court filed August 11, 1977 (see ____ RI ____, 379 A.2d 344 (1977)). Reference is made to the Revised Judgment entered therein on January 30, 1976 for the history and travel of the case up to the time of the entry of that Judgment. At the conclusion of testimony in September 1979 the parties filed a memoranda of facts and law and oral argument was had on December 18, 1978. Upon consideration of such testimony, memoranda and oral argument, this Court does hereby render the following judgment:

1) The Authority is entitled to recover on its principal complaint the sum of $4,119,312.15 for remedial painting costs incurred as a result of faulty preparation of the surface of the steel and faulty application thereto of paint coatings on the

various structural members of the Newport Bridge as erected by defendant Bethlehem, which sum represents 75% of the total proven remedial costs.

2) Defendant Bethlehem is entitled to recover on the first count of its counterclaim the balance of the contract price in the sum of $804,996.55, together with interest thereon at the rate of 8% per annum, which should be credited against the sum to which the Authority would be entitled under Paragraph 1 hereof.

3) Defendant Bethlehem is entitled to recover nothing under Count II of its counterclaim and said count of the counterclaim is denied and dismissed as against the Authority and Parsons.

4) Defendant Bethlehem is entitled to recover nothing under Count III of its counterclaim and said count of the counterclaim is denied and dismissed as against the Authority.

5) The Authority is entitled to recover interest at the rate of 8% per annum upon 75% of the:

i) Amount paid to Oliver B. Cannon & Sons, Inc. for remedial painting;

ii) Upon the amount paid to Parsons, Brinckerhoff, Quade & Douglas for engineering supervision of remedial painting; and

iii) Upon amounts paid to M D C Industries, Inc. for blasting grit used in the remedial painting,

over and above the credit due to Bethlehem on Count I of its counterclaim. Under this computation the plaintiff Authority is entitled to the sum of $957,112.07 in interest to be added to the principal sum set forth in Paragraph I of this Judgment as of April 6, 1979.

6) Judgment is hereby rendered in favor of the plaintiff Authority against defendants Bethlehem and INA in the total sum of $4,215,067.70, plus costs.

7) Judgment is rendered in favor of counterclaim defendant Parsons for its costs.

8) The findings of fact and the conclusions of law which have been made by this Court are set forth in a written decision filed March 15, 1979, which is appended hereto and made a part hereof, and will therefore not be repeated in this Judgment document.

9) There is attached hereto and made a part hereof a detailed calculation of the interest figures and credits referred to herein.

10) All interest calculations reflected in this Judgment were made to April 6, 1979. This Judgment, therefore, shall bear interest at the legal rate from that date to the date of discharge.

_____

Clerk

ENTER:

_____

Weisberger, J.
4/6/79

9

CALCULATION OF NET JUDGMENT ASSUMING:

1) The Bethlehem Steel Corporation counterclaim of $804,996.55 earns simple interest at the rate of 8% per annum from October 28, 1970.

2) Against 75% of each Authority payment, the Bethlehem counterclaim and interest is applied as a credit so that no interest accumulates on any Authority payment until Bethlehem has received credit at the earliest possible moment.

3) After the exhaustion of credit, 75% of each payment made by the Authority to Parsons, Cannon and M.D.C. bears interest at the rate of 8% per annum to March 30, 1979.

4) From the total due the Authority, including interest, there is deducted the total due Bethlehem, plus interest, to obtain the amount of net judgment.

Calculation of Simple Interest at 8% on Bethlehem Steel Corporation Counterclaim of $804,996.55 and Application Thereof as Credit Against Authority Payments

1) October 28, 1970 through June 2, 1971				
217 days @ 8% = .047561	×	$804,996.55	=	$ 38,286.44
75% of 6/2/71 payment		53,209.22		
		$751,787.33		
2) June 2, 1971 through June 29, 1971				
27 days @ 8% = .005917	×	751,787.33	=	4,448.33
75% of 6/29/71 payment		82,687.18		
		609,100.15		
3) June 29, 1971 through August 10, 1971				
42 days @ 8% = .009205	×	669,100.15	=	6,159.07
75% of 8/10/71 payment		120,985.51		
		548,114.64		
4) August 10, 1971 through August 16, 1971				
6 days @ 8% = .001315	×	548,114.64	=	720.77
75% of August 16, 1971 payment		36,243.40		
		511,871.24		

5) August 16, 1971 through September 2, 1971				
17 days @ 8% = .003726	×	511,871.24	=	1,907.23
75% of Sept. 2, 1971 payment		17,144.17		
		494,727.07		
6) September 2, 1971 through September 10, 1971				
8 days @ 8% = .001753	×	494,727.07	=	867.26
75% of 9/10/71 payment		132,706.15		
		362,020.92		
7) September 10, 1971 through October 1, 1971				
21 days @ 8% = .004602	×	362,020.92	=	1,666.02
75% of 10/1/71 payment		162,589.12		
		199,431.80		
8) Balance—October 1, 1971		199,431.80		
75% of October 1, 1971 payment		15,736.77		
		183,695.03		
9) October 1, 1971 through November 5, 1971				
35 days @ 8% = .007671	×	183,695.03	=	1,409.12
75% of 11/5/71 payment		12,104.29		
		171,590.74		
10) Balance—November 5, 1971		171,590.74		
75% of 11/5/71 payment		93,287.97		
		78,302.77		

11) November 5, 1971 through November 24, 1971				
19 days @ 8% = .004164	×	78,302.77	=	326.05
75% of 11/24/71 payment		12,214.99		
		66,087.78		
12) November 24, 1971 through December 10, 1971				
16 days @ 8% = .003506	×	66,087.78	=	231.70
75% of 12/10/71 payment		41,822.49		
		24,265.29		
13) December 10, 1971 through January 21, 1972				
42 days @ 8% = .009205	×	24,265.29	=	223.36
75% of 1/21/72 payment		8,683.95		
		15,581.34		
14) January 21, 1972 through January 31, 1972				
10 days @ 8% = .002191	×	15,581.34	=	34.14
75% of 1/31/72 payment		7,053.28		
		8,528.06		
15) January 31, 1972 through March 15, 1972				
43 days @ 8% = .009424	×	8,528.06	=	80.37
75% of 3/15/72 payment		24,961.55		
		16,433.49		56,359.86

16) Balance of 3/15/72 payment			16,433.49
			39,926.37
17) 75% of 4/18/72 payment			11,943.75
			27,982.62
18) 75% of 6/23/72 payment			23,267.06
			4,715.56
19) 75% of 7/25/72 payment	=	9,204.12	
Balance of interest due B S CO		4,715.56	
		4,488.56	

This sum starts to draw interest for R.I.T.B.A. from July 25, 1972 at 8% per annum to March 30, 1979

All payments after July 25, 1972
75% thereof draws interest for R.I.T.B.A. at 8% per annum to March 30, 1979

Counterclaim amount due Bethlehem	804,996.55
Interest thereon due Bethlehem	56,359.86
Total due Bethlehem, including interest	861,356.41

DATE OF PAYMENT	AMOUNT OF PAYMENT	B. S. CO. CREDIT 25%	DUE AUTHORITY 75%	INTEREST RATE	INTEREST	B. S. CO. CREDIT
6/2/71	$ 70,945.63	$ 17,726.41	$ 53,209.22	—	—	$ 53,209.22
6/29/71	110,249.57	27,562.39	$82,687.18	—	—	82,687.18
8/10/71	161,314.02	40,328.51	120,985.51	—	—	120,985.51
8/16/71	48,324.53	12,081.13	36,243.40	—	—	36,243.40
9/2/71	22,858.90	5,714.73	17,144.17	—	—	17,144.17
9/10/71	176,941.53	44,235.38	132,706.15	—	—	132,706.15
10/1/71	216,785.49	54,196.37	162,589.12	—	—	162,589.12
10/1/71	20,982.36	5,245.59	15,736.77	—	—	15,736.77
11/5/71	16,139.06	4,034.77	12,104.29	—	—	12,104.29
11/5/71	124,383.96	31,095.99	93,287.97	—	—	93,287.97
11/24/71	16,286.66	4,071.67	12,214.99	—	—	12,214.99
12/10/71	55,763.32	13,940.83	41,822.49	—	—	41,822.49
	$ 1,040,975.03	$ 260,243.77	$ 780.731.26			$ 780,731.26

DATE OF PAYMENT	AMOUNT OF PAYMENT	B. S. CO. CREDIT 25%	DUE AUTHORITY 75%	INTEREST RATE	INTEREST	B. S. CO. CREDIT
1/21/72	$ 11,578.60	$ 2,894.65	$ 8,683.95	—	—	$ 8,683.95
1/31/72	9,404.38	2,351.10	7,053.28	—	—	7,053.28
3/15/72	33,282.07	8,320.52	24,961.55	—	—	24,961.55
4/18/72	15,925.00	3,981.25	11,943.75	—	—	11,943.75
6/23/72	31,022.75	7,755.69	23,267.06	—	—	23,267.06
7/25/72	12,272.16	3,068.04	9,204.12	.535456 (on $4488.56)	2,398.49	4,715.56
7/25/72	104,206.60	26,051.65	78,154.95	.534356	41,762.57	80,625.15
8/2/72	8,200.86	2,050.22	6,150.64	.532603	3,275.85 fwd	780,731.26
8/22/72	112,085.50	28,021.38	84,064.12	.528219	44,404.27	861,356.41 (total BSCo Credit)
8/24/72	9,375.30	2,343.83	7,031.47	.527780	3,711.07	
8/24/72	10,435.81	2,608.95	7,826.86	.527780	4,130.86	
8/28/72	174,979.88	43,744.97	131,234.91	.526904	69,148.20	
	$ 532,768.91	$ 133,192.25	$ 399,576.66		$ 168,831.31	

DATE OF PAYMENT	AMOUNT OF PAYMENT	B. S. CO. CREDIT 25%	DUE AUTHORITY 75%	INTEREST RATE	INTEREST
10/24/72	$ 13,150.36	$ 3,287.59	$ 9,862.77	.514410	$ 5,073.51
10/24/72	148,921.23	37,230.31	111,690.92	.514410	57,454.92
11/20/72	43,406.57	10,851.64	32,554.93	.508493	16,553.95
1/10/73	8,861.08	2,215.27	6,645.81	.497315	3,305.06
3/1/73	1,721.54	430.39	1,291.15	.486356	627.96
5/8/73	1,739.29	434.82	1,304.47	.471452	614.99
6/5/73	2,951.38	737.85	2,213.53	.465315	1,029.99
6/11/73 (1)	14,720.35	3,680.09	11,040.26	.463999	5,122.67
7/12/73	121,419.61	30,354.90	91,064.71	.457205	41,635.24
7/25/73	8,165.51	2,041.38	6,124.13	.454356	2,782.54
8/31/73	120,331.36	30,082.84	90,248.52	.446246	40,273.04
8/31/73	10,507.02	2,626.76	7,880.26	.446246	3,516.53
	$ 495,895.30	$ 123,973.84	$ 371,921.46		$ 177,990.40

DATE OF PAYMENT	AMOUNT OF PAYMENT	B. S. CO. CREDIT 25%	DUE AUTHORITY 75%	INTEREST RATE	INTEREST
9/25/73	$ 133,475.66	$ 33,368.92	$ 100,106.74	.440767	$ 44,123.75
10/10/73	2,000.00	500.00	1,500.00	.437479	656.22
10/10/73	10,846.30	2,711.58	8,134.72	.437479	3,558.77
10/29/73	154,369.43	38,592.36	115,777.07	.433315	50,167.94
11/19/73 (2)	106,610.22	26,652.56	79,957.66	.428712	34,278.81
11/29/73	20,317.75	5,079.44	15,238.31	.426521	6,499.46
2/22/74 (2)	67,940.80	16,985.20	50,955.60	.407890	20,784.28
5/14/74	7,642.65	1,910.66	5,731.99	.390136	2,236.25
6/3/74	5,062.36	1,265.59	3,769.77	.385753	1,464.62
8/27/74	3,063.69	765.92	2,297.77	.367123	843.56
9/11/74	2,166.00	541.50	1,624.50	.363835	591.05
6/5/75	58,721.11	14,680.28	44,040.83	.305315	13,446.33
	$ 572,215.97	$ 143,054.01	$ 429,161.96		$ 178,651.04

DATE OF PAYMENT	AMOUNT OF PAYMENT	B. S. CO. CREDIT 25%	DUE AUTHORITY 75%	INTEREST RATE	INTEREST
6/24/75	$ 453.58	$ 113.40	$ 340.18	.301150	$ 102.45
7/7/75	93,002.96	23,250.74	69,752.22	.298301	20,807.16
7/25/75	180,392.35	45,098.09	135,294.26	.294356	39,824.68
8/28/75	186,116.01	46,529.00	139,587.01	.286904	40,048.07
9/2/75	10,755.35	2,688.84	8,066.51	.285808	2,305.47
9/5/75	5,390.21	1,347.55	4,042.66	.285150	1,152.76
10/3/75	145,273.22	36,318.31	108,954.91	.279013	30,399.84
10/6/75	5,445.72	1,361.43	4,084.29	.278356	1,136.89
10/29/75	5,564.64	1,391.16	4,173.48	.273315	1,140.67
11/5/75	136,474.90	34,118.73	102,356.17	.271780	27,818.40
12/17/75	3,318.41	829.60	2,488.81	.262575	653.50
1/19/76	76,777.43	19,194.36	57,583.07	.255342	14,703.12
	$ 848,964.78	$ 212,241.21	$ 636,723.57		$ 180,093.27

DATE OF PAYMENT		AMOUNT OF PAYMENT	B. S. CO. CREDIT 25%	DUE AUTHORITY 75%	INTEREST RATE	INTEREST
6/29/76		$ 2,012.00	$ 503.00	$ 1,509.00	.220054	$ 332.06
7/20/76		135,828.77	33,957.19	101,871.58	.215452	21,948.44
8/13/76		184,341.68	46,085.42	138,256.26	.210191	29,060.22
8/16/76		9,057.62	2,264.41	6,793.21	.209534	1,423.41
9/14/76		287,081.57	71,770.39	215,311.18	.203178	43,746.49
9/15/76		6,115.56	1,528.89	4,586.67	.202958	930.90
10/16/76		6,451.01	1,612.75	4,838.26	.196164	949.09
10/29/76		141,828.42	35,457.11	106,371.31	.193315	20,563.17
10/29/76		5,493.49	1,373.37	4,120.12	.193315	796.48
11/18/76		183,397.59	45,849.40	137,548.19	.188931	25,987.12
12/8/76		3,962.05	990.51	2,971.54	.184547	548.39
1/6/77	(3)	136,140.73	34,035.18	102,105.55	.178191	18,194.29
		$ 1,101,710.49	$275,427.62	$ 826,282.87		$ 164,480.06

DATE OF PAYMENT	AMOUNT OF PAYMENT	B. S. CO. CREDIT 25%	DUE AUTHORITY 75%	INTEREST RATE	INTEREST
7/14/77 (4)	$ 165,955.19	$ 41,488.80	$ 124,466.39	.136767	$ 17,022.89
7/14/77	14,678.42	3,669.61	11,008.81	.136767	1,505.64
7/26/77	9,364.46	2,341.12	7,023.34	.134136	942.08
8/25/77	165,027.73	41,256.93	123,770.80	.127561	15,788.33
8/25/77	13,074.64	3,268.66	9,805.98	.127561	1,250.86
9/21/77	100,528.00	25,132.00	75,396.00	.121643	9,171.40
9/26/77	10,073.90	2,518.48	7,555.42	.120547	910.78
9/29/77	9,424.87	2,356.22	7,068.65	.119890	847.46
10/26/77	4,265.81	1,066.45	3,199.36	.113972	364.64
10/26/77	10,657.37	2,664.34	7,993.03	.113972	910.98
10/26/77	146,932.32	36,733.08	110,199.24	.113972	12,559.63
11/30/77	10,152.88	2,538.22	7,614.66	.106301	809.45
	$ 660,135.59	$ 165,033.91	$ 495,101.68		$ 62,084.14

DATE OF PAYMENT	AMOUNT OF PAYMENT	B. S. CO. CREDIT 25%	DUE AUTHORITY 75%	INTEREST RATE	INTEREST
11/30/77	$ 4,280.94	$ 1,070.24	$ 3,210.70	.106301	$ 341.30
12/8/77	139,808.90	34,952.23	104,856.67	.104547	10,962.45
12/19/77	84,906.10	21,226.53	63,679.57	.102136	6,503.98
1/30/78 (5)	4,857.76	1,214.44	3,643.32	.092931	338.58
1/18/78	3,521.87	880.47	2,641.40	.095561	252.41
5/25/77	2,374.56	593.64	1,780.92	.147726	263.09
	239,750.13	59,937.55	179,812.58		18,661.81
	$ 5,492,416.20	$ 1,373,104.16	$ 4,119,312.04		950,792.03
				6,320.04	*
					$ 957,112.07

Total due Authority	$ 5,070,104.07
Total due B. S. Co.	861,356.41
Net Judgment	$ 4,208,747.66
	6,320.04*
Final Net Judgment as Entered	$ 4,215,067.70

* Interest @ 8% for 7 days — March 30, 1979 thru April 6, 1979 on $ 4,119,312.04 = $ 6,320.04

FOOTNOTES TO REDUCE PAYMENTS BY $62,652.08.

1) This payment was actually $28,797.35, but we have reduced it by $14,077.00, which represents the conceded cost of handrail painting in 1973, based upon cost to do so in 1977. By deducting it from this first payment in 1973 for 1973 work, B S Co. is receiving greatest benefit by a reduction in interest charged.

2) The payment on November 19, 1973 was reduced by $20,199.19
The payment on February 22, 1974 was reduced by 7,013.89
$27,213.08

This is the amount paid to paint span E G 1 which had initially been done with the glass flake epoxy. These items constitute one of the matters conceded at oral argument.

3) This payment was reduced by $256.00. Cost of 7 tons of grit @ $38.00 per ton used on tower maintenance painting at end of 1976 season.

4) This payment was reduced by $227.60 to reflect credit for 20 gallons of paint used by mistake on maintenance work

20 × $11.38 per gallon © $227.60

5) This payment has been reduced by $20,878.40 composed of the following items:

a) Labor — 6% factor — rigging west stringer span at end of 1977 season	$11,127.00
b) Inventory of 780 gallons @ $11.38 used in 1978 for maintenance painting	8,876.40
c) Charges for truck carrying grit to maintenance painting in 1977 $175.00 per month for 5 months	875.00
	$20,878.40

Recapitulation of reductions:

1)	$14,077.00
2)	27,213.08
3)	256.00
4)	227.60
5)	20,878.40
	$62,652.08

6) It should be noted that the payment on October 21, 1977 to Cannon reflected in the attached calculation figures in the amount of $100,528.00, reflects an actual reduction of $19,741.84 which is the adjusted credit due on the Mobil paint which was erroneously included in Requisition #498.

IV (A)

Decision of Superior Court Filed December 31, 1975.

State of Rhode Island — Superior Court
Newport, Sc.

Rhode Island Turnpike and Bridge Authority Plaintiff	)	
v.	)	
Bethlehem Steel Corporation and Insurance Company of North America Defendants	)	C.A. File No. 70-237
v.	)	
Walter S. Douglas, et al Counterclaim Defendants	)	

DECISION.

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Travel of the Case.

This case has come before the Court for hearing on the merits on the basis of a complaint which was filed by the Rhode Island Turnpike and Bridge Authority on December 7, 1970, in the Superior Court for the County of Newport. The complaint was brought against Bethlehem Steel Corporation and the Insurance Company of North America by the Rhode Island Turnpike and Bridge Authority. Thereafter, the defendants petitioned for removal of the case to the United States District Court for the District of Rhode Island. After extensive argument in the United States District Court, an order of remand was filed on March 15, 1971. Subsequently, the defendants' answer and counterclaim were filed on April 2, 1971 in the Superior Court, and on April 22, 1971, the reply of the Rhode Island Turnpike and Bridge Authority to the defendants' counterclaim was filed. Upon motion of the defendants, the firm of engineers who had been selected by the Rhode Island Turnpike and Bridge Authority, namely, Parsons, Brinckerhoff, Quade & Douglas, was made party defendant to the second count of Bethlehem's amended counterclaim.

On April 30, 1971, an order was entered transferring the case to Providence County. All subsequent pleadings and other documents have been filed in that county. At various times during the pleadings process, the complaint was amended, the defendants amended their answer and counterclaim, and the plaintiff and counterclaim defendants amended their respective replies. Ultimately after extensive discovery proceedings, the trial of the case began on January 16, 1974, and continued for a period of 89 trial days, which concluded on December 18, 1974. Upon conclusion of the trial, counsel asked for and received permission to file memoranda of fact and law. Upon the filing of said memoranda,

dates were set for final oral argument, which said dates were postponed on account of illness from time to time. The argument took place on July 1, 2 and 3, 1975. Thereafter, further time was given to counsel to file supplemental memoranda on the issue of interest. These memoranda were duly filed on July 16, 1975 on behalf of the plaintiff and the defendant.

Hereafter in this decision, the plaintiff, Rhode Island Turnpike and Bridge Authority, will be referred to as "AUTHORITY." The defendant and counterclaimant Bethlehem Steel Corporation will be referred to as "BETHLEHEM." The defendant Insurance Company of North America will be referred to as "INA." The counterclaim defendants, Parsons, Brinckerhoff, Quade & Douglas, will be referred to as "PARSONS."

The Pleadings.

In the AUTHORITY'S amended complaint, damages are sought against BETHLEHEM and its surety, INA, in the sum of $6,000,000 for alleged breach of contract. This claim is based upon a written contract executed on April 25, 1966 by the AUTHORITY and BETHLEHEM. Among other obligations, the complaint alleges that it was BETHLEHEM'S obligation under the contract to perform surface preparation of the steel components of the suspended superstructure and approach spans of the Newport Bridge (all of which was to be constructed by BETHLEHEM) and to apply paint to all ferrous metal and galvanized surfaces in accordance with specifications contained in the contract. The AUTHORITY alleges that BETHLEHEM has breached this contract in that it failed adequately to prepare the surfaces required to be painted and to apply properly the paint in accordance with specifications. The complaint further alleges that BETHLEHEM refused to do necessary remedial work which was re-

quired to be done as a result of its initial failure to fulfill its contractual obligations as to surface preparation and application of paint. As a result, the AUTHORITY contends that it was required to do the necessary remedial painting and will be required in the future to do further remedial painting at great cost and expense.

BETHLEHEM and INA deny the allegations of the complaint with respect to breach of contract and damages, and in addition BETHLEHEM has filed an amended counterclaim in three counts against the AUTHORITY, to the second count of which it has made PARSONS a party defendant.

The first count of the counterclaim seeks damages from the AUTHORITY in the amount of $811,661.27 for the unpaid balance of the contract price.

In the second count of the counterclaim, BETHLEHEM alleges that the Newport Bridge paint system, as required by the contract specifications, was inherently defective and unsuitable for the purpose of providing protection to the structural steel of the Newport Bridge. It further alleges that in spite of BETHLEHEM'S proper performance of surface preparation and application of paint in accordance with the contract, the AUTHORITY and PARSONS required BETHLEHEM to replace deteriorated paint and to repeat the application of paint. Consequently, it is alleged that as a result of the faulty specifications and the requirements of the AUTHORITY and PARSONS, BETHLEHEM was required to perform additional work and incur extra expenses for which it seeks damages of two and a half million dollars from the AUTHORITY and PARSONS.

In the third count of the counterclaim, BETHLEHEM alleges that it was prevented from performing its work under the contract in a timely and efficient manner because of delays and interference on the part of the AUTHORITY. BETHLEHEM further asserts that these delays caused addi-

tional expenses and costs for which it seeks recovery in the amount of four and a half million dollars from the AUTHORITY.

The reply of the AUTHORITY to the counterclaim denies the allegations in respect to liability and damages and also interposes affirmative defenses to the second and third counts of the counterclaim which include allegations of waiver, estoppel and acts of God.

PARSONS' reply to the second count of BETHLEHEM'S amended counterclaim denies the allegations with respect to liability and damages and also poses certain defenses to jurisdiction (which were not pressed at the trial) and asserts that there is no privity of contract between the counterclaim defendants and BETHLEHEM.

Summary of Evidence.

The first witness in the case was Edwin O. Bailey of Astoria, New York, who was previously employed by the Associated Press as a photographer, and who has acted in various capacities as professional photographer since 1953. He testified that he took motion pictures of the Newport Bridge in December 1970 and in November of 1973. He testified that these motion pictures were fair and accurate portrayals of that which the witness saw and observed on the dates in question.

The next witness was Bernhard Hilmar Buschbo n of Saratoga Springs, New York, who had been employed by PARSONS as Chief Inspector for the Newport Bridge project from August of 1970. He testified that he was present when Mr. Bailey took the pictures in December of 1970 and in November of 1973 and that he was capable of describing the locations and the objects photographed on both occasions.

The next witness was Francis G. Dwyer of Middletown, Rhode Island, who served as Chairman of the AUTHORITY for twelve years, from 1959 until 1971. He stated that in 1965, the AUTHORITY received a recommendation from PARSONS that an epoxy paint system be used to protect the structural steel to be erected by BETHLEHEM on the Newport Bridge. The recommendation stated that the epoxy system would cost approximately one million dollars more than the traditional paint system, but that it would have a minimum life of ten years. The AUTHORITY in considering this recommendation took into account the desirability of lower maintenance cost during the first years after construction of the bridge had been completed when debt service would be at its highest point. These considerations caused the AUTHORITY to believe that the additional expenditure would be worthwhile.

Mr. Dwyer further stated that during the bridge construction he visited the site frequently. He noted that steel members were stacked without fenders and also that steel members would be hoisted into place with chain slings which scratched the paint surface.

Mr. Dwyer also stated that he had received no communication, either written or oral, complaining or commenting about the adequacy of the paint system. He stated that he first learned of a complaint about the adequacy of the paint system at the opening of the bridge when Mr. Canning (an AUTHORITY employee) mentioned that some BETHLEHEM officials had complained about the paint system. He heard this again during the summer of 1969 and at an engineering dinner in New York during the winter of 1969-1970.

After authenticating a large number of items of documentary evidence, Mr. Dwyer testified that he called a meeting of the members of the AUTHORITY on November 10, 1970, at which meeting the engineers where authorized to proceed

with remedial painting. This authorization resulted in solicitation of proposals and ultimately in the signing of a contract for remedial painting with Oliver B. Cannon & Son. After the signing of the contract for remedial painting, Mr. Dwyer's term expired April 1, 1971, and he was not reappointed to the AUTHORITY. Mr. Dwyer freely conceded on cross-examination that he had no expertise in the field of preparation or application of paint.

The next witness was John J. White of Tuckahoe, New York. Mr. White was eighty-three years of age and retired at the time of his testimony. His most recent professional employment was in the capacity of Specifications Engineer for PARSONS. Mr. White graduated from New York University in 1912 as a Bachelor of Science in Engineering. He was later awarded the degree of Civil Engineer, which he stated to be the equivalent of a Master of Science degree. He was a member of the American Society of Civil Engineers, the American Society of Testing Materials, the American Society of Military Engineers, the American Roadbuilders' Association, and a number of other learned and engineering societies, including the American Testing Institute. He was licensed to practice engineering in New York and New Jersey. He has edited a chapter on specifications in an engineering handbook, and also wrote or co-authored a number of publications and papers which he delivered from time to time before various learned societies.

Mr. White has had employment and executive engineering experience in the field of construction, astronomical surveying, fabrication of structural steel, estimating costs for various types of commercial and residential buildings, water distribution systems, schools, dry docks, and floating dry docks.

Mr. White joined PARSONS as Chief Specifications Engineer in 1945 and remained in this position until 1969 when he retired. Mr. White was still active as a consultant. While

serving with PARSONS, Mr. White did specifications work on bridges, tunnels, airports and all types of heavy construction. He worked every year for forty-five years on some type of bridge project. He testified in detail concerning his bridge experience which included the recoating of the Rainbow Bridge at Niagara Falls. He worked on the largest double swing bridge in the world, at York River, Virginia. This work included specifications for protective coatings in respect to bridges over the Cape Cod Canal, a bridge from Elizabeth, New Jersey to Staten Island, New York, a bridge across the Susquehanna River, a bridge across the Lehigh River in Pennsylvania, and a vertical lift bridge in Rio Honda, Texas. Mr. White testified concerning his experience in regard to a number of other bridges and tunnels in Florida, Bermuda, New York, New Hampshire, Oregon and Delaware.

In respect to all of the bridges upon which he did work, Mr. White prepared the protective coating specifications.

In preparing the specifications for steel coatings, Mr. White used a manual and also engaged the services of another expert in the coating field, Mr. William J. Bradley. He used Mr. Bradley's help in preparing specifications for sixteen bridges, ranging from Pennsylvania to Colorado.

Mr. White stated that he prepared the specifications for the substructure and the superstructure of the Newport Bridge. He was also involved in the feasibility studies which preceded the preparation of the contract documents. In 1965, he became engaged in preparation of the superstructure specifications. The type of coating to be selected was the subject of extensive in-house discussions with his colleagues at PARSONS for some time. Mr. White was not wholly satisfied with the traditional paint systems made up of red lead, pigment and linseed oil and with intermediate coats of aluminum, because of the relatively short life span of such systems. He stated that such systems could normally be expected to last

approximately seven years at best. Consequently, he sought a more durable coating system. In this connection he considered with Mr. Bradley an epoxy type protective coating. Mr. Bradley had written and delivered a paper on this subject in 1962 before a meeting of highway officials.

Mr. White also investigated various existing structures where epoxy type coatings had been used. He met with Mr. Bradley at PARSONS' office in New York with other staff persons participating in the meeting.

They discussed the relative merits of different paint systems used in the past in light of cost, durability and time factors. Among numerous systems discussed was one invented by Mr. Bradley called a glass flake epoxy, as well as the conventional three-coat epoxy system.

Mr. White considered the conventional epoxy system as a most durable coating. It can be either pure or adulterated. It may be pigmented. The epoxy must be cured chemically by a catalyst. This would require three coats, each a minimum of two mils in thickness.

Mr. White stated that epoxy systems had been in use for approximately ten years in structural protective coatings for off-shore drilling platforms, structural steels and other metals. Such a system had never before been used on a bridge structure.

As a result of this meeting, it was decided to recommend a conventional three-coat epoxy system. The Bradley glass flake system was carefully considered but was regarded as a close second choice.

Mr. White discussed the paint system with Mr. Ben Frye of BETHLEHEM. He did this in order to confirm with a prospective bidder the feasibility of the use of this system and to explore the relative merits of this and other paint systems. He also discussed with Mr. Frye the relative costs of the various systems. He posed eighteen questions which were answered by Mr. Frye.

According to Mr. White, Mr. Frye stated that epoxy systems had not previously been used on bridges, but had been used in the petrochemical industry and in the protection of offshore drilling platforms. He stated that Mr. Frye recommended the three-coat epoxy system. He was most helpful in discussing the thickness of the coatings and other details of applications. Mr. Frye adverted to the chalking phenomenon of the epoxy, which does not affect its durability. Mr. Frye suggested a period of fifteen years as the probable life of such a coating. He also mentioned that it would run about thirty-five to forty dollars per ton of steel erected in cost. Mr. Frye recommended a lighter color as being less likely to lose its pigmentation, as well as being superior for cosmetic effect. Mr. White testified that Mr. Frye indicated that BETHLEHEM had painted some pilings with an epoxy coating about ten years prior to the conversation and that this coating had held up well.

Mr. White stated that Mr. Frye was a legendary figure in the steel industry, known from coast to coast for his expertise in coatings for steel structures. Mr. Frye had been in charge of one of BETHLEHEM'S coating laboratories and was a man of the highest knowledge, integrity and reputation.

Mr. White and Mr. Frye discussed the various paint systems, including the red lead linseed oil system, the inorganic zinc system, a vinyl system, as well as the epoxy systems. One advantageous quality of the red lead linseed oil system was its economy and also the ability of linseed oil to penetrate mill scale and adhere to the steel surface below.

After writing a report and memorandum relative to this conversation, Mr. White conferred December 21, 1965 with representatives of the American Bridge Company, a subsidiary of United States Steel, concerning the proposed paint system. Following these conferences and preparation of

memoranda, Mr. White recommended to Mr. Hedefine, the partner of PARSONS who would be in charge of the project, that the three-coat epoxy system be adopted as the coating to be specified for the Newport Bridge. Mr. Hedefine concurred, and Mr. White designated Mr. Bradley to draft the specifications for this paint system.

Although the Bradley glass flake epoxy system was applied to certain portions of the bridge for experimental purposes, it was stipulated by the parties that no claim was made in relation to this glass flake epoxy application, and therefore its utilization is not relevant to this trial.

Mr. White incorporated the epoxy specifications into the contract documents, deleting therefrom the standard provisions in the Rhode Island Roads and Bridge Specifications concerning paint preparation and application.

Mr. White then reaffirmed his previous statements that he had been familiar with the use of epoxy coatings in respect to offshore drilling rigs in Louisiana, as well as coatings for structural steel in environmental conditions similar to bridges for approximately ten years prior to the preparation of the Newport Bridge specifications.

Subsequently, Mr. White attended a meeting at Pittsburgh Testing Laboratories in order to explore the coating procedures specified in the contract with Mr. Bradley and other interested parties. Thereafter, Mr. White had a meeting with representatives of Bethlehem Steel Company in Chicago. Present at this meeting were Mr. Pressler and two staff members of Pittsburgh Testing Laboratories as well as representatives of Armstrong Paint & Varnish Company. At the Chicago meeting, some outdoor tanks, a portion of which were concrete and a portion of which were steel, were blast cleaned and coated with the epoxy system and in certain cases with the glass flake epoxy. All three coats of the epoxy system were applied on different days to these tanks. The

consensus of the Chicago meeting was satisfaction with the outcome. This meeting had taken place September 1, 1966, and included on behalf of BETHLEHEM Mr. Ben Frye and Mr. Ken Fine.

On December 29, 1966, Mr. White visited the Pottstown Plant of BETHLEHEM. At this meeting were present Mr. Ken Fine, Mr. Ben Frye, Mr. Taylor, a supervisor of welding, Mr. Pearson, and other employees of BETHLEHEM. Mr. Bradley and Mr. Pressler of Pittsburgh Testing Laboratories, were there also. They had gathered to observe the facilities which had been prepared for coating structural steel at the plant. Mr. White noticed that there were a number of space heaters in the area, but three out of four of the space heaters were turned off because of noxious fumes. He was assured that this situation would be remedied. Mr. White observed that the facility for blast cleaning seemed to be well equipped. However, he brought to the attention of Mr. Taylor and Mr. Frye, as well as other representatives of BETHLEHEM, that there were emissions of particles from the blast-cleaning operation which became electrically charged and contaminated the surface of structural steel members which were already coated. Mr. White suggested that this could set up a corrosive effect. He was assured that this condition would be corrected.

He also noted that a number of tower cells had been shipped to Newport without the application of inspection tags by personnel of Pittsburgh Testing Laboratories. It was agreed that this would be checked later at Newport.

Mr. White also expressed disappointment concerning the temperature, because the specifications required a temperature of at least 40° F., but full cure of the coating could not be attained at less than 59° F.

Mr. White discussed the paint spray equipment. Mr. Frye indicated that he was having trouble with the airless type of

spray mechanism. Consequently, an air type spray was allowed to be substituted.

Mr. White was shocked to observe that there was a hole in the roof piled high with snow. The area below was roped off. This condition was not in accordance with specifications, whose requirements concerning temperature were being ignored. Mr. White was dressed in his overcoat and muffler at the time. This clothing felt comfortable in the prevailing temperature. When he expressed surprise that Mr. Frye would have permitted such an arrangement, he learned that Mr. Frye had not been consulted.

In January 1967, Mr. White met with Mr. Pressler, Mr. Fine, Mr. Frye, Mr. Lafayette and others in the assembly yard where structural members were stored in Newport, Rhode Island. They inspected tower cells which had previously been shipped.

On May 4, 1967, Mr. White inspected certain steel splice plates. It was absolutely necessary that the splice plates not be coated in any way so as to develop appropriate friction. A sample splice plate was set up and doused with salt water. They found some incipient corrosion due to contamination from the blast-cleaning material. It was agreed that the edges of the plates would be coated with a thinned coating.

In June 1967, Mr. White made an on-site inspection of the Newport Bridge, west approaches, in order to see how the steel coating appeared to be going forward. He found substantial improvement, but did note evidence of skimpy film on the edges, instances of imbedded grit and nonuniformity of film application. Ben Frye was also present at this inspection. On July 19 or 20, 1967, there was another inspection at which Ben Frye, Ken Fine, Lafayette and others were present. Mr. White found that the coating of the tower cells was unsatisfactory. He noted imbedded grit and skimpy application. They reached a consensus that touching up was

necessary, depending for its intensity on how deep the grit was found to be. Mr. White also noted considerable rust on the towers.

The first complaint which Mr. White received from BETHLEHEM or its representatives concerning the adequacy of the specifications for paint covering came from a man named Gearhart when Mr. White and he were riding in a taxi on the way from Newport Airport to the place of dedication of the Newport Bridge. This occurred approximately June 27, 1969. On this occasion, Mr. Gearhart stated that he hoped he never encountered such a paint system specification again. He asserted that it had caused BETHLEHEM great losses. Mr. White replied, "That's your hard luck." He also replied to Mr. Gearhart that he expected that Gearhart would be in the front line seeking to bid on further specifications of similar type. Thereafter he had no further discussions concerning the paint system with any other representative of BETHLEHEM down to the date of his testimony.

On cross-examination, Mr. White again affirmed that epoxy coatings had not been tested on a bridge under actual weather conditions. He also stated that he gave BETHLEHEM the option to apply the intermediate and final coats in the shop or in the field, as BETHLEHEM might determine. He also stated that a similar type of epoxy coating was applied to the Cape Fear Bridge on the lift span and enriched zinc applications were used for the approaches. The Cape Fear Bridge was located in North Carolina and was constructed and painted shortly after the construction of the Newport Bridge.

Also on cross-examination Mr. White stated that his visit to the Pottstown Plant on December 28, 1966, was for the purpose of viewing a demonstration. He agreed that although a heavy snow storm had just taken place, the demonstration went forward for his benefit and that of the other observers.

He further agreed that at the juncture between the old and new shops (the new shop had been erected to do the Newport Bridge work), there was an accumulation of snow of approximately six feet on the roof. The area beneath was roped off to protect the workmen against possible collapse. This area was open at the roof to the weather. The temperature was below 40° at this point. He recalled that there were no painting operations under way on December 28, 1966. He stated that he was in error when he recalled that he asked for a paint demonstration on December 28, 1966.

On cross-examination, Mr. White stated that he had retired in the late fall of 1968 and did not inspect the Newport Bridge thereafter. However, as of June 28, 1969, he noted that paint failure was beginning on the bridge above the deck railing.

On redirect examination, he stated that he was aware at all times pertinent to this controversy that Mr. Bradley was associated with the Armstrong Paint & Varnish Company and that Mr. Bradley was acquainted with such representatives of BETHLEHEM as Messrs. Frye, Strauss, and others. He further stated that BETHLEHEM eventually bought the epoxy paint coating from Armstrong, and Mr. Bradley undoubtedly profited from this purchase.

The next witness was Sidney B. Levinson of New Rochelle, New York. He was engaged as President of David Litter Laboratories, having joined the David H. Litter Company in 1952. The laboratory end of the business became a separate corporation in 1973. Mr. Levinson was 62 years of age and was in charge of all activities of the David Litter Laboratories. He analyzes data and prepares reports. He has acted as a consultant to firms on coatings and materials. The David Litter Laboratories are regarded as specialists in the paint industry. Mr. Levinson received his Bachelor of Science in Chemistry in 1932 and his Bachelor of Science in Engineering the same year. He received a Master of Science degree in

1933. He is a member of the American Chemical Society, the American Society for Testing of Materials, the National Association of Corrosion Engineers, the New York Paint and Coating Association, as well as several other learned and technical societies. In many of these societies he has served as president or held other office. He has been the author of about twenty-four articles and has written chapters in several books in regard to paints. Several of these articles and volumes were introduced into evidence as Plaintiff's Exhibits 59 through 66. Mr. Levinson has given more than fifty lectures on coating systems, of which twenty related to epoxy coatings in some degree. He has been engaged in the painting and coating field for forty years. Mr. Levinson has received a number of awards from various paint and technical organizations. There was some question about his having received the George B. Heckel Award of the Society for Paint Technology. However, upon extensive cross-examination, it appeared that he received a lesser award under the Heckel name for a presentation which he gave to the Society. Mr. Levinson has been familiar with epoxy paint systems since they were first developed. He has dealt with various problems relating to adhesion of coatings in respect to the Cook County sewage plant and on other projects. His firm has been retained to deal with such problems and to find solutions.

He was contacted concerning the Newport Bridge in June of 1970 by Dr. Howard Simpson, who requested that he inspect the bridge and evaluate the paint problem. Mr. Levinson visited the Newport Bridge July 16, 20 and 31, 1970. He was to determine by observation the cause of the paint failure and then to determine in the laboratory whether the product which had been applied as coating met the specifications and also whether this coating constituted a good paint system.

It was Mr. Levinson's opinion that the paint system specified for the Newport Bridge should have a life expectancy of

at least eight years if properly applied to appropriately prepared steel members. When he viewed the bridge, there was excessive corrosion beginning at the edges and/or adjacent to scratched or abraded areas. The paint seemed to have failed prematurely over large areas of the bridge. Mr. Levinson picked up some five gallon cans of primer and finish coat while he was at the bridge site. He also requested a further sample from Armstrong Paint & Varnish Company. Thereafter, he tested the physical characteristics of the paint.

Mr. Levinson stated that he had not previously known of epoxy coatings on bridges except for the Newport Bridge. However, epoxy coatings had been used with good success on other steel structures such as ships, offshore drilling platforms, petrochemical structures and the like. He has never seen a failure as extensive as at Newport in the use of epoxy systems. He performed certain quality tests on the samples, seeking to test for viscosity, pot life, settling, remixing, weight per gallon, air drying characteristics, air spray, gloss, hardness, adhesion, impact resistance and corrosion resistance.

He tested to see whether the primer and finish coats met the requirements of the specifications, to determine the application potential of the covering and to determine whether this system was suitable for structural steel. These tests indicated that the coating actually used by Bethlehem met the contract specifications, save for one small deviation where the finish coat was below the specification requirements as to fineness. This would not have affected performance in any substantial way.

The paint also passed tests for sagging, although the finish coat required appropriate technique in order to avoid substantial sagging.

Mr. Levinson went on to describe the four types of epoxy systems. The first type is a two-component system, consist-

ing of epoxy resins with solvent and pigment. The two components react together and may produce excess viscosity. This two-component system was used on the bridge. The other types are epoxy-ester, the single package epoxy which requires baking, and the epoxy molecule which is used alone as a lacquer (Intergard is a zinc-rich epoxy of the epoxy molecule type).

In testing for adhesion and other qualities, Mr. Levinson was aware of the environmental conditions at Newport, where temperature changes are severe, winds are strong, humidity is high, and salt spray strikes the bridge and drips down.

He stated that the paint specified for Newport consisted of three coats of two-component, unesterfied epoxy. There was a prime based on red lead and an intermediate primer with a little black coloring in it to distinguish it from the first primer. There was also a finish coat. He stated that solvent is designed to help in applying paint. It does not contribute to the thickness of the coating. The more one adds solvent, the thicker the paint must be applied to reach the desired minimum dry film thickness. He stated that the surface must be properly prepared to remove rust, corrosion and mill scale.

For comparison in testing, Mr. Levinson selected a paint system which had been recommended by the National Paint Council for use on bridges. This consisted of a primer, intermediate and finish coat. He also selected five other different paints. He then took steel channels, blast cleaned them in part, leaving one end untouched except to remove burrs. The other end was rounded. The paint was applied in stripes by spray and smoothed by brush. The thickness had to be varied in accordance with the quality of the paint. He then exposed these channels to a salt spray in a container. The channels were left for 800 hours at a temperature of approximately

100°. This container was termed a salt-fog cabinet. This test produced no failure whatever in the Armstrong paint system. After 800 hours, assistants scored the coating right down to the steel. One of each type channel was scored. Then Mr. Levinson placed an unscored channel back for further exposure for an additional 400 hours. After 800 hours, he looked for blistering and the degree of corrosion.

These tests after 800 and 1200 hours, respectively, indicated that the Armstrong paint system was superior to the comparative systems, such as those specified by the Steel Structures Painting Council, the International epoxy paint system, American Association of State Highway Officials system, and the Enjay epoxy system, in respect both to blistering and corrosion. Mr. Levinson stated that the exposure of 1200 hours in a salt fog cabinet was more than equivalent to the age of the bridge when he examined it in July 1970. A large number of these channels upon which the various paint systems had been applied were introduced into evidence.

As a result of these tests, Mr. Levinson concluded that the paint system as specified for the Newport Bridge should have provided a highly effective coating against corrosion. It was his opinion that the system was suitable for use in the Newport marine environment.

He also compared the Newport specified coating against the new proposed Steel Structures Painting Council specification for epoxy coatings. He put both coatings on sample blast-cleaned steel panels. He then tested them for adhesion after immersion, salt resistance after 500 hours, accelerated weathering, and for hardness. As a result of these tests, he determined that the Newport paint system was easily equal to the new proposed SSPC specifications for polyamide epoxy coating systems.

He stated that he visited Newport Bridge September 21, 1973 to inspect the remedial work being carried out on the

bridge. At the time of his inspection, workmen were blast cleaning a section in preparation for application of new paint. He had in his possession sample standard panels as developed by the National Association of Corrosion Engineers. He compared these samples to the blast-cleaned areas at panel points 11 through 15 of the bridge, and took photographs, which were introduced into evidence. He also measured thickness of the coatings, which ranged from 6.1 to 8.7 mils on the average. He noted that the area in which remedial painting had been done showed minimal corrosion. He was advised that this area had been painted for approximately two and a half years. He noted that the west abutment area, after five to six years of paint life, was in much better condition than the east abutment area. This indicated to him that the specified paint system is satisfactory when properly applied to properly prepared steel. He was of the opinion that this system as specified would be highly suitable and would give good protection against corrosion over its expected life. He estimated that the life expectancy of the refinished areas should be eight years or thereabouts with a minimum of maintenance. He stated that the blast cleaning which he observed appeared slightly better than the SP 6 specified in the contract.

On cross-examination, Mr. Levinson went over the details of his testing procedure. He indicated that he had never written specifications for any exterior large structure. He also stated that he had observed shockingly extensive corrosion on the Newport Bridge, considering the fact that the paint had been applied for less than three years.

The next witness was Saul Spindel of Bayside, New York. He was also employed by David Litter Laboratories, as Technical Director and Vice President. He had received a Bachelor's Degree from Brooklyn College in 1960. Before attending college in 1947 he went to work for E. M. Wanderman

Company, in a quality control laboratory where he was engaged in testing varnish products to determine suitability of specifications. In 1948, he worked for Clover Leaf Paint and Varnish Company in the quality control laboratory performing tests on varnishes and paint products. He was later promoted in this firm to a position in the development laboratory where he worked on commercial and industrial coatings. This work included alkyds, resins, and epoxies. After service in the Korean conflict, he began working with David Litter Laboratories in 1959 as a chemist, where he was engaged in evaluation and formulation of products associated with the coating industry. He was promoted from chemist to group leader, thence to Technical Director and Vice President. He has taken special courses in relation to paint and coating topics. He is a member of various national, regional and local paint and corrosion societies. He holds a Corrosion Specialist certificate from the National Society of Corrosion Engineers. He has prepared more than 200 reports for clients of David Litter Laboratories. He has also authored or co-authored a number of articles which have appeared in national paint and coating journals. He is familiar with epoxy coating systems, as a result of his work with Clover Leaf Paint and Varnish Company, as well as his work on epoxy formulations for David Litter Laboratories. He has found epoxies to be durable and highly suitable for paint coverings. He has found that epoxies would normally be more durable than would conventional systems.

In conjunction with Mr. Levinson, Mr. Spindel worked out testing objectives to determine whether the sample paints utilized at Newport met the requirements of the specifications, whether the coating was suitable for the bridge, whether the physical characteristics of the paint samples met requirements, whether this coating would protect the Newport Bridge against corrosion, whether the specified

coating compared favorably with other coating systems. He supervised and personally observed all tests for physical characteristics. From all tests as to physical characteristics, Mr. Spindel determined that the sample paint product was adequate for use in accordance with the specifications of the contract.

Then Mr. Spindel purchased various types of paints as specified by SSPC, AASHO, International epoxy system, and Enjay zinc chromate epoxy. He applied these paints to steel channels which had been purchased from a local supplier and which had been given the equivalent of an SP 6 blast cleaning. He applied the various paints to the channels in three coats ranging in film thickness from 6 to 7½ mils. After the channels were painted and cured they were placed in a salt-fog cabinet to test their resistance to corrosion. At the conclusion of 800 hours of exposure, an in-depth evaluation was made of the channels and essential data were recorded. Thereafter, some channels were scored with parallel lines and returned to the salt-fog cabinet for an additional 400 hours. These were then withdrawn for further evaluation. In respect to blistering and corrosion, Armstrong performed best overall in comparison with the other four systems. He found that all of the epoxy systems used in the sample were superior to conventional paint systems. The Armstrong paint was best overall except for blistering along score lines wherein it was generally superior to all except the International epoxy system.

Mr. Spindel stated that the 1200 hour test was longer than those usually performed in the laboratory. It was equivalent to more than the life of the paint system at the time of Levinson's visit to the bridge in July 1970. Mr. Spindel had inspected the bridge in Newport and noted that the marine environment in Newport is severe and aggressive. In his opinion the Armstrong paint system utilized was effective as a

means of protection against corrosion when properly applied to appropriately prepared steel structures. He stated that this system as specified would be highly suitable for application to and protection of the Newport Bridge. Thereafter, he compared the Newport specified system as furnished by Armstrong to the new proposed Steel Structures Painting Council epoxy specifications. After testing both in the salt-fog cabinet for accelerated weathering, adhesion and other characteristic as applied to blast-cleaned panels, he found that the Newport system was at least equal to the new SSPC specified coating system.

On November 8, 1973, Mr. Spindel visited the Newport Bridge for the purpose of observing personnel of BETHLEHEM remove samples from the remedial paint area of the bridge. Earlier, on September 13, 1973, he had visited the bridge in order to observe the remedial painting operations being performed by Cannon's personnel. He also watched the blast-cleaning operation on portions of the west suspended span. He noted that where the remedial painting had been performed, the condition of the paint was excellent. There was only about two per cent corrosion, and he observed blistering only in two small areas. Adhesion was also excellent in this remedial painted area. He took eight film thickness readings at random in this remedial painted area and found that thickness varied from 6 to 12 mils. He also observed the west approach girder spans and noted that the paint was in very good condition after five to six years. There was some corrosion, but in light of the age of the coating, the overall condition was very good.

At this point Mr. Spindel was deferred for further testimony and the next witness was Dr. Robert Muggli, of Homewood, Illinois. He had been employed by various laboratories after receiving his Bachelor of Science in Chemistry in 1951, his Masters degree in 1956, and his Ph.D. in Organic Chemistry in 1960. He has taken special courses in

the field of spectography and microscopy. He has worked as a research chemist on paint, both in the field of formulation and testing. He is a member of numerous chemical and research and microscopic societies. He has published some articles, including his doctoral dissertation. At the time of his testimony he was a senior research chemist employed by McCrone Associates. McCrone Associates perform nonroutine analyses of articles and materials. This firm specializes in testing with highly sophisticated equipment including the electron microscope, spectroscopes and the like. Dr. Muggli has had experience with analyses of epoxies and is generally familiar with the literature on epoxy paint systems. He stated that Dr. Simpson approached McCrone Associates by letter in November of 1970 and eventually authorized an analysis by Dr. Muggli. Dr. Muggli and an associate senior research chemist visited the Newport Bridge and took samples. Dr. Muggli then examined carefully the specification requirements. He determined that such epoxy paint systems should have a useful life of from eight to fifteen years. He was aware that such coating systems had been used for ships, offshore drilling structures and similar marine type structures, but did not know of their use on bridges at that time. His first visit to the bridge was in December of 1970. He inspected the west abutment, the truss spans, the girder sections and the east pier. He took samples at forty or fifty sites on the bridge, probably a total of 150 to 200 samples. He attempted to take samples from areas where obvious failure was apparent and also from areas where the paint seemed to be intact. The west abutment area seemed to be generally good in condition. He took a few samples from this location, but taking samples was difficult because the adhesion of the paint to the steel was so strong. In fact, he had to take these samples by use of a chisel rather than jackknife. At this point a number of photographs were introduced into evidence which illustrated the marked corrosion of the various members.

Dr. Muggli made a second inspection on April 1 and 2 of 1971. He further observed the test areas. In the west abutment area, the spots which had been scraped bare had corroded, but the corrosion had not crept to the adjacent portions. In the span area, the results were mixed. In some portions, corrosion had crept to the adjacent areas. In others it had not. He further examined the test areas on the west abutment portion of the bridge February 10, 1974, and found that the corrosion in the bare spots had still not crept significantly to adjacent areas. He noted that the paint was generally holding up well on the west abutment. Dr. Muggli examined various areas of the bridge for paint condition and adhesion. He examined paint chips which were removed both optically and microscopically, as well as by the use of other equipment. This examination indicated that mill scale and other substances were on the chips. He stated that mill scale had a chemical formula of Fe_3O_4 or magnetite. These tests disclosed that all of the paint samples were epoxy polyamide paint. The samples generally conformed to the specifications, and where there were deviations from the specifications no problem would result therefrom. Both the tests and the observations disclosed to Dr. Muggli that there was no lack of suitability in the coating system. His inspection indicated that the paint worked very well when properly applied. In his opinion the paint itself was not the cause of failure.

He measured a number of the paint chips for thickness by use of microscopic equipment. In a number of instances he found that the various coats were below specifications. On the underside of certain chips he observed mill scale. Also the microscope showed severe thinning of the paint chip at either end where the chips came from the corner of structural members. He noted that the mill scale samples have different coloring than corrosive materials. The mill scale, he stated,

was blackish in color with a layered appearance, where the corrosion product is a reddish iron oxide. A great number of his various samples were introduced into evidence in photographic form. One hundred photographs were admitted as subdivisions of Plaintiff's Exhibit 83.

In all cases where the paint was pulled off, there was some corrosion or mill scale beneath. Dr. Muggli and his associates visually noted mill scale and corrosion and then analyzed the two as a further check. He stated that mill scale, if tightly adhered to the surface, will eventually loosen and part from said surface. If it is loosely adhered, it forms a mass underneath the paint which will expand and cause the paint to loosen and corrode. Ultimately, paint over mill scale will break and corrosion will occur. In parts of the suspended portion of the bridge there was some loss of paint coating, but in others failure was widespread. In his opinion, this failure occurred due to faulty preparation of the steel or due to faulty handling of the steel.

On cross-examination, Dr. Muggli stated that he determined the composition of hematite and magnetic mill scale by x-ray diffraction and by the use of the electron microscope. He stated that one could not tell just from looking at the photos in the book which had been marked as Plaintiff's Exhibit 83 whether they showed mill scale or rust products. He stated that he spent two years before filing his report reaffirming his results by additional tests and inspections of the bridge. After observing the microscopic samples in the tests he went back to what he termed the macrocosm, which was the bridge itself. He stated that although he had read about epoxies, he first began to test or analyze epoxies from about 1967 or 1968. He said the Newport paint failure was the most drastic he had ever seen on a paint job only two or three years old. He stated that the iron oxide formed on the surface of steel is mill scale. It is hematite and magnetite, of which

the magnetite is the dominant substance. He stated that he did not see the chemical material FeO in the mill scale when he examined it. He was then given a series of imbedded paint chips and envelope containing paint chips which were marked as Defendants' exhibits. He stated that he could not tell with certainty which chips contained mill scale and which contained corrosive or rust scale without further analysis by techniques in addition to microscopic examination.

On redirect examination, using previously-admitted exhibits, Dr. Muggli pointed out that the materials on the underside of the paint chips (without regard to identifying such materials) were on the steel when the paint was applied. This was apparent from the adhesion of the paint to the material plus the exact conformity in contour between the material and the paint. This was true when viewed microscopically in relation to a number of photographs contained in Exhibit 83. Dr. Muggli concluded that it was unnecessary to closely examine the paint system itself, because it was apparent that the paint on certain portions of the bridge where properly applied was holding up very well. Therefore, he concluded that the problem was faulty application; either poor surface preparation, insufficient application, or a combination of the two.

On cross-examination, Dr. Muggli stated that he did not find the substance "wustite" in any of the Newport Bridge x-ray diffraction samples. It was his finding that the black-colored areas consisted of 90 to 95 per cent magnetite (Fe_3O_4), with traces of hematite (Fe_2O_3). In the reddish areas he found the same two materials, but in reverse proportions. Dr. Muggli also recognized that a bulletin published by W. C. McCrone Associates indicated that x-ray diffraction data on mill scale "revealed that FeO is present as well as Fe_3O_4." Nevertheless, Dr. Muggli affirmed his opinion that the substance which he had observed in many instances on the underside of the sample chips was in fact mill scale.

The next witness was Mr. Sidney Zecher of Chestnut Hill, Massachusetts, who is employed as an associate member of the PARSONS firm. Mr. Zecher attended the City College of New York for one year and then enlisted in the United States Army in 1938. He entered the United States Military Academy, from which he graduated in 1943 with a Bachelor of Science degree. In addition to his Army experience, he worked as a construction inspector for the New York Water Board where he dealt with structural design between 1948 and 1950. He was a candidate for a Master of Science degree at New York University when he was recalled to service during the Korean conflict. During that period he helped to set up a Korean military academy and advised on the subjects of supply and construction. He worked on a section of the Garden State Parkway as Resident Engineer between 1952 and 1955. He worked for PARSONS from 1955 to 1956 as Project Manager on the Garden State Parkway. Thereafter, he worked for the engineering firm of King & Gavaris as Resident Engineer on a section of the Connecticut Turnpike. He was then advanced to the position of Project Manager for all that firm's projects. He worked on Interstate Highway 91 and on various other projects in different parts of New York between 1956 and 1966. During this time he became a general partner in that firm.

He then returned to PARSONS in 1966 as Chief of the Construction Department, which included the making of surveys and inspections. He was also in charge of preparing budgets for work in progress as well as supervising proposals for new work.

He testified that Mr. J. W. Kinney was the Project Manager for PARSONS at the Newport Bridge. It was Mr. Zecher's job to review the budget and to consult with Mr. Kinney on major construction problems when necessary.

From February 1966 to 1967, Mr. Zecher made weekly visits to the bridge to consult on construction problems relating to the Perini construction of the substructural portions of the bridge. When BETHLEHEM began its work, Mr. Zecher's participation diminished until about June 1970. In June 1970, Mr. Zecher stated that he became involved with the paint problem. At about this time the PARSONS inspection staff was increased, and there was a dispute between BETHLEHEM and the AUTHORITY as to whether BETHLEHEM would return to the job.

In August 1970, Mr. Kinney informed Mr. Zecher that the AUTHORITY was dissatisfied with the BETHLEHEM paint work and had requested a close study of the problem. Mr. Zecher attended the meeting after making a field inspection. He also suggested that a meeting should be held with the field representatives of BETHLEHEM. Such a meeting was arranged for mid August, 1970. Mr. Dalby and other top representatives of BETHLEHEM were present as well as Mr. Hogan, Mr. Hynes, and upper management representatives of all sides.

Mr. Zecher testified that the BETHLEHEM representatives took the position that their only obligation was to paint those portions of the gusset plates which had not previously been painted, and that BETHLEHEM had no further obligation in respect to paint. Finally, he stated, the BETHLEHEM representatives agreed to clean and paint the gusset plates. Eventually this task was performed. At the end of the 1970 painting season, BETHLEHEM representatives took the position that the job had been finished.

Thereafter, Mr. Zecher was assigned under the direction of Mr. Douglas, a partner in the PARSONS firm, to arrange for remedial painting of the bridge. Mr. Zecher consulted with four firms which might potentially perform this work. Representatives of these firms and Mr. Zecher made inspec-

tions on site. Mr. Zecher believed that the work should be broken down into four phases. Phase I would relate to the suspended spans. He suggested that each contractor should study the problem to such extent as was desirable. Mr. Zecher also suggested a cost plus arrangement. He furnished each contractor with copies of the paint specifications which constituted Section 7 of Contract No. 3 as entered into between BETHLEHEM and the AUTHORITY.

Proposals were received from Hudson Maintenance Corporation, George Tarbuck Company, Klaas Brothers, Inc., and the Kite Company. Also, a further proposal was received from Oliver B. Cannon Company (hereinafter sometimes referred to as Cannon).

After meeting with representatives of each contractor and reviewing each proposal carefully, Mr. Zecher prepared an analysis of each proposal which was submitted to the AUTHORITY over the signature of Mr. Douglas. A meeting of the members of the AUTHORITY took place at the PARSONS office in New York on January 4, 1971. At this meeting the representatives of PARSONS recommended to the AUTHORITY members that they enter into an agreement with Cannon. This recommendation was based upon Cannon's prior experience with epoxy systems, its prior experience in structural steel, Cannon's sound business background, and the belief that Cannon was capable of performing a job of this magnitude.

Thereafter, a meeting was held January 25, 1971, at which the AUTHORITY accepted the recommendation that Cannon be retained. Mr. Zecher supervised the preparation of the contract documents for the remedial painting work. For this project the specifications of Section 7 of Contract No. 3 (the BETHLEHEM contract) would apply, except that no experimental glass flake epoxy paint would be applied. Also there had to be modifications of interpretation of these specifica-

tions, since all paint must of necessity be applied in the field rather than in the shop. Where an area required cleaning, the specifications required it to be cleaned to a standard equivalent to SSPC No. 6. Adjacent areas would be cleaned to a standard equivalent of SSPC No. 7.

Mr. Zecher arranged for methods of cross-checking of labor and materials utilized. He also arranged for paint to be manufactured by Bruder Company and for a paint testing service to be applied to each batch of paint as manufactured. The testing firm retained was E. L. Conwell & Company of Philadelphia, Pennsylvania. All reports submitted by the testing firm indicated that the paint manufactured by Bruder met the specifications in all material aspects. During the 1971 painting season work started either in late April or early May, as soon as weather conditions would permit. The experience gained during this period gave rise to a decision to remove virtually 100 per cent of the paint in the Phase I area. They still attempted to avoid cleaning gusset plates and were able to do so occasionally, but even this was difficult of implementation.

As they proceeded with the remedial paint work, about eight bays developed pinpoint rusting. Moreover, one area had been prime-coated in 1971 prior to tropical storm Doria. This area had to be recleaned and reprimed after the tropical storm.

As a result of this combination of difficulties, the AUTHORITY actually paid as of December 31, 1971, $965,590.59 for approximately 40 per cent of Phase I, although the estimate for the entire Phase I had been $775,000.

In the 1972 painting season, approximately 102 bays were done. The same standards were observed as to surface preparation and application. The same standards were applied in the 1973 painting season as well.

During the 1971, 1972 and 1973 seasons, between 19 and 20 thousand gallons of paint were used in this remedial painting work. The average dry film thickness of this paint was 8.2 mils and above. Through the end of the 1973 painting season, $2,342,370.63 was paid to Cannon by the AUTHORITY. Of this sum, approximately 2.3 million dollars was expended to complete Phase I operations. For this work, PARSONS charged the AUTHORITY an additional $232,000 for inspection and supervision.

Mr. Zecher on cross and redirect examination emphasized that it was extremely difficult to blast clean the paint from the structural steel members without affecting adjacent areas, so that it became more practical to clean virtually 100 per cent of the area rather than attempting to save adjacent paint.

The next witness was Bernhard Buschbom. Mr. Buschbom started as Chief Field Inspector for the Newport Bridge in August 1970. He remained as Chief Field Inspector during 1971, 1972 and 1973. He graduated from the Bargschule in Dortmund, Germany in 1953. He came to the United States in 1960 and became engaged as part of a survey crew for a highway construction firm. He did test boring work for the firm of C. Pischell, Inc. When this firm went out of business in 1962, Mr. Buschbom went to work for PARSONS. He worked on the Grand Central Parkway, Garden State Parkway, Cape Fear River Bridge and Interchange 540 in Albany, New York. At this point he was transferred to Newport.

On many of his jobs, Mr. Buschbom served as Chief Field Inspector. Mr. Buschbom began inspecting linseed oil type paint on the Grand Central Parkway. His first inspection of epoxy paint came about 1966 at the Cape Fear Bridge. He believes that the paint system at Cape Fear was identical to the system at Newport. In fact, in emergency situations, paint from the Newport Project was used at the Cape Fear

project. Mr. Buschbom took a number of slides of the Newport Bridge which were introduced into evidence as Plaintiff's exhibits, along with a large number of envelopes containing paint samples from various portions of the bridge.

He testified that in August of 1970, he arrived at the Newport Bridge on V.J. Day. Since no work was being performed, he walked over the bridge and inspected it visually. He was shaken by what he saw. He had never seen such a massive paint failure in his prior experience. The next working day he met the inspectors and checked their assignments. After five or six weeks he cut the number of inspectors down from nine to six, and eventually reduced their number to three.

At this point BETHLEHEM'S subcontractor, a firm called Conomos, was engaged in a variety of work projects. Its employees were doing touch-up work on gusset plates, touch-up work on splice plates and edges. Also, work was going forward on both towers. About 90 per cent of the gusset plates had been blast cleaned and primed with a paint termed Intergard. Conomos employees were divided into five or six work crews on the suspended span. Each crew had a ten-gallon spray device along with wire brushes and other tools. Paint was being applied in 90 per cent of instances by airless and conventional spray devices. Whenever a painter wanted a new supply of paint, he would go and procure a batch.

On one occasion, Mr. Buschbom noted that diesel fuel was being used as a thinner. On another occasion no catalyst was used in mixing the paint. Although the painters were instructed, they seemed to operate on their own. If a painter picked up a bucket of gray paint, it might consist of the pigment portion only.

The inspectors made complaints to Mr. Buschbom about the quality of the Conomos workmanship. These complaints were made known to representatives of Conomos. The de-

fects would be remedied for a while and then they would fall back into their old routine. There seemed to be no fixed policy or procedure on the part of the Conomos workers. Mr. Buschbom never quite knew what to expect of them.

The Conomos employees left the job in mid November, 1970. They took all equipment with them, and Mr. Cox, a representative of BETHLEHEM, stated that Conomos was all through with the job. Completion papers were given to Mr. Buschbom which he forwarded to Mr. Zecher. From November 1970 to the spring of 1971, Mr. Buschbom participated in the inspection of the bridge with Mr. Zecher and prospective remedial paint contractors. In April 1971, the new paint season began. Mr. Buschbom met with Cannon employees as well as with Mr. Zecher and set forth ground rules for the field painting. The Cannon painters were carefully instructed concerning the technique of blast cleaning. They were initially instructed to try to save as much good paint as possible, but this proved to be impractical. Although efforts to save good paint continued, gusset and splice plate painting usually could not be preserved. In the painting seasons for 1972 and 1973, a No. 6 commercial blast was the standard applied.

Generally, about 15 men would blast clean from 8 a.m. until about 4 p.m. It would take one and a half hours to paint a portion which had been blast cleaned in eight hours. Therefore, it took about 60 to 80 per cent of the total effort to clean and blast the structural steel rather than to apply paint.

Mr. Buschbom described in considerable detail the inspection techniques utilized to assure appropriate wet film readings as well as the taking of dry film readings with a magnetic gauge. He also described the manner by which the paint was distributed and applied. He then described the use of solvents to clean the surface to be painted of fog, salt and diesel smoke.

He stated that on August 28, 1971, tropical storm Doria struck the bridge. Certain areas had been prime coated when the storm occurred. After the passage of the storm, it was necessary to remove salt from the areas which had been prime coated. These areas were washed down with water and alcohol and cleansed with steam. This was done about two days after the storm had passed.

On cross-examination, Mr. Buschbom stated that the diesel fuel which he saw mixed with the paint was never actually used. The mistake was corrected before any use was made of the batch of paint. He also stated that Cannon used certain of the Conomos painters to some extent. He estimated that approximately 15 of the 80 men employed by Conomos were used in the Cannon operation. He described these men as "the cream of the crop."

The next witness was presented by way of deposition and was Mr. T. William Spilman of Bethlehem, Pennsylvania, who has served as Manager of Engineering for BETHLEHEM since 1967. Prior thereto, he served as Chief Engineer of the Eastern District Engineering Division of the Fabricated Steel Construction Department of BETHLEHEM. He held this latter position in 1965 and 1966. His education resulted in the receipt of a Bachelor of Science degree in Civil Engineering.

It was Mr. Spilman's responsibility to prepare estimates for bidding purposes on painting jobs for structural steel. If problems were encountered on preparing a bid, Mr. Spilman would consult with Ben Frye, who was BETHLEHEM'S expert on coatings for steel. Mr. Spilman "imagined" that he consulted with Frye on the Newport Bridge, but has no specific recollection as to what was said or at what stage the consultation took place.

Mr. Spilman was aware that William Bradley was a specialist in paint and coating systems prior to December 1965. He

also recalled that John White was employed by PARSONS and that he may have had some contact with him in 1965 or 1966. There may have been a telephone meeting on December 6, 1965, in which White and Ben Frye participated, concerning which Mr. Spilman wrote a memo on March 24, 1966, but Mr. Spilman had no recollection of that meeting or conversation at the time of his deposition.

The next witness, who was introduced by way of deposition, was William H. Jameson of Bethlehem, Pennsylvania. Mr. Jameson received a Bachelor of Arts degree and a Master of Arts degree, as well as a Bachelor of Science in Civil Engineering, from the University of Pennsylvania. He was first employed by McClintock Marshall, an independent fabricator which merged with BETHLEHEM in 1931. Thereupon, Mr. Jameson became an employee of BETHLEHEM. He worked in the Engineering Department in various grades until he became Chief Engineer in 1961. He remained head of the Engineering Department until his retirement on January 31, 1966.

Mr. Jameson was chairman of the committee which produced the 6th Edition of the Manual of Steel Construction. He also served as Chairman of the American Welding Society Bridge Committee on writing specifications for welded highway and railway bridges.

In 1965 and 1966, Mr. Jameson was in general charge of all estimating work as well as oversight on all problems of erection of structures. His specialty was the erection of bridges, but his knowledge of paint and coating systems was negligible, though this aspect of construction also came under his supervision. He referred all coating problems to Ben Frye and other experts in the employ of Bethlehem.

Jameson stated that he knew William Bradley as one who was interested in coatings for steel. After refreshing his recollection with a letter written by him December 31, 1965,

he vaguely recalled a conversation with Bradley in December of 1965, concerning coating specifications for the Newport Bridge. He acknowledged an exchange of correspondence with Bradley on surface preparation for the epoxy coating, but had no recollection as to any specific elements of the subject matter discussed. He was also unaware of any recommendations or advice which might have been given by Ben Frye on this subject.

The next witness was John W. Frame, who was introduced by way of deposition. Mr. Frame testified that he resides in Bethlehem, Pennsylvania and has been employed at the Research Department of BETHLEHEM since 1946. In 1965 and '66 he was Manager of the Forming and Finishing Research Department. This was essentially the same position which he now holds, excepting for some reorganization of divisions. Among his divisions was one relating to organic coatings. When this division became a separate entity, Ben Frye became the Section Manager. Although Mr. Frame was administratively responsible for the work of the division, he did not supervise Frye's work from a technical point of view. Mr. Frame had received a Bachelor's degree in Engineering from the University of Missouri, a Master's degree in Metallurgical Engineering from Lehigh University, and a Ph.D. in Metallurgical Engineering from Lehigh University. He stated that he is a metallurgist, not an organic chemist or a paint expert. Mr. Frame's department was part of the Homer Research Laboratories, which are owned by BETHLEHEM.

Although Mr. Frame had no recollection of the discussions concerning paint specifications for the Newport Bridge, he acknowledged signing a memorandum prepared by Mr. Frye for his signature on February 25, 1966. This memorandum indicated that the epoxy formulation details of the Newport specifications were satisfactory.

Other portions of Mr. Frame's deposition relate to matters not now in controversy, concerning the glass flake epoxy coating, and will not be summarized here. Still other portions relate to conclusions made by Mr. Frye which will be dealt with elsewhere in the summary of testimony.

The next witness was William J. Bradley, and was introduced by way of deposition. Mr. Bradley was 66 years of age at the time of his deposition and testified that he was presently President and Chairman of the Board of Bradley Glass Flakes Coating, Inc. He graduated from Mount St. Mary's College in Emmitsburg, Maryland with a Bachelor of Arts degree at the age of 17. In 1924, he went to work for the DuPont Company, paint division. He apparently was assigned a variety of work in this division in order to learn the business. In 1935, he was appointed Assistant to the Manager of the Special Industrial Department of DuPont. This consisted of structural steel fabrication and included railroads, petroleum industry and aircraft industry, as well as marine industrial paints and coatings. From 1935 to 1946, Mr. Bradley worked with the American Bridge Division of United States Steel plus other structural steel fabricators in connection with the subject of paints and other protective coatings.

After leaving the DuPont Company in 1946, Mr. Bradley was employed by Bradley Paint Engineers, Inc., a firm of which he was the principal figure, which served its customers by designing paint systems which would meet the particular problem of the customer. After 1949, Mr. Bradley was employed by Pittsburgh Plate Glass Company in its Paint Division, where he remained until 1962. In this employment, Mr. Bradley dealt with a large variety of industrial enterprises in connection with paint and coating systems. In this connection he had his first contact with epoxy coatings. Mr. Bradley recommended the formulation by Pittsburgh Plate Glass of an epoxy primer for flow coat application to laundro-

mats. He also dealt with the American Bridge Division concerning a contract from Kaiser Aluminum and Chemical Corporation wherein specifications were prepared for an epoxy coating system.

Upon leaving Pittsburgh Plate Glass Company in 1962, Mr. Bradley became self-employed as an advisor on paint for steel. He also served as a manufacturers' representative for three paint manufacturers, namely Armstrong Paint & Varnish Works in Chicago, Watson Standard Paint Company of Pittsburgh, and Jaegle Paint Company in Philadelphia. He also rendered consulting services to PARSONS and various other engineering firms. He stated that he had written the paint specifications for the Mackinac State Bridge. Mr. Bradley stated that he was never paid for his consulting services to PARSONS or other engineering firms but would receive commissions in the event that the contract for paint was eventually placed with one of the firms for which he served as representative. In many instances the orders were not placed with these firms, and Mr. Bradley received no compensation.

However, on the Newport Bridge project he received reimbursement for expenses in connection with the consulting work on the paint system for that project. This was in the amount of $1,000. It is not entirely clear as to whether this was a fee or reimbursement for expenses. Mr. Bradley indicated that his expenses exceeded the amount of the payment, but it may have been in the form of a fee or honorarium.

Mr. Bradley testified that in 1962, while still associated with Pittsburgh Plate Glass Company, he devised a system for an epoxy coating for bridges at the request of an official of the Bureau of Public Roads in Washington. The formulation for this system was prepared by employees of Pittsburgh Plate Glass. Mr. Bradley stated that he has never been quali-

fied to assume the task of preparation of formulations for any type of paint. He indicated that his work was in the preparation of the system, as opposed to making up the specific formula.

Mr. Bradley testified that he was contacted by Mr. White of PARSONS in the latter part of 1965 concerning a coating system for the Newport Bridge. Mr. White stated that he had investigated the maintenance problem of a bridge previously constructed near the Newport site and was looking for a coating system which would be better and more durable than the conventional linseed oil system which had proved costly to maintain in the Newport environment. Mr. Bradley ultimately submitted recommendations on a vinyl coating system and also on a three-coat epoxy system. After consideration, he recommended the three-coat epoxy system which was later incorporated into the Section 7 specifications for Contract No. 3. Mr. Bradley prepared the system and developed the concept, but the formulations were prepared by approximately five chemists employed by the Armstrong Paint and Varnish laboratory. After Bradley submitted the specifications to Mr. White in draft form, Mr. White made certain changes and returned the specifications to Mr. Bradley as modified. Mr. Bradley caused the modified specifications to be reviewed by personnel at Armstrong and also discussed the modified specifications with representatives of BETHLEHEM and the American Bridge Division of United States Steel Company. Among the BETHLEHEM representatives who were contacted by Mr. Bradley were Messrs. Jameson, Spilman, Alexy, the Purchasing Agent, and Frye.

Mr. Bradley testified that Mr. Frye responded to his request for opinion by stating that the epoxy system was to be preferred over a vinyl system. Mr. Frye stated that he would recommend a three-coat epoxy system. Both Bradley and

Frye were aware that epoxy coatings had not hitherto been used on bridge structures, but that such coatings had been used on other marine type installations, including ships and tanks. Mr. Bradley also discussed the costs of the new system with Mr. Frye and suggested that Frye contact PARSONS directly on this point, rather than Bradley's acting as intermediary. He also discussed costs with Mr. Jack Coneen of BETHLEHEM. Mr. Bradley stated that Ben Frye recommended the provision in the specifications which required prestriping of edges. Mr. Bradley stated that he discussed with BETHLEHEM representatives the necessity that steel surfaces be thoroughly cleaned before application of epoxy paint. This epoxy coating system, though superior in many respects to linseed oil, would not tolerate the contaminants as well as the traditional linseed oil formulation was capable of doing.

Mr. Bradley testified that the same specifications as those prepared for the Newport Bridge were used on a bridge constructed at Cape Fear, North Carolina. The only difference was that the American Bridge Division of United States Steel, which constructed this bridge, shipped the steel unpainted and sand blasted and applied paint to the steel in the field, while BETHLEHEM received permission to apply all three coats of paint in the shop before shipping.

The balance of Mr. Hynes' examination of Mr. Bradley consisted of a lengthy technical discussion concerning various types of paint coatings, in which Mr. Bradley exhibited considerable knowledge of the properties of paint components, though he admitted that he was not a formulator, but essentially a conceptual producer of paint systems.

In an examination by Mr. Dolan, Mr. Bradley recounted a considerable list of published materials, lectures given to various paint associations and also a lengthy list of engineering firms by which he had been consulted on various projects.

He also related an account of his being consulted on a paint system during World War II for P-40 pursuit planes. His recommendation for this paint system was accepted by Du-Pont and Curtis Wright and resulted in increasing the speed of the planes.

The next witness was Stephen G. Pinney of Blue Hill, Pennsylvania, who was employed by Oliver B. Cannon & Son, Inc. as Vice President. Mr. Pinney received a Bachelor of Science degree from the University of Connecticut in Agricultural Engineering and also a Bachelor of Science degree in Civil Engineering as well as a Master of Science degree in Business Management from the University of Florida. He has also taken special courses and attended seminars on matters relating to corrosion. He holds a certificate as a corrosion specialist from the Society of Corrosion Engineers. He is a member of several honorary engineering societies.

Mr. Pinney testified that he worked for two and a half years for Champlin Box Company, after which he was employed by NASA at Cape Canaveral, Florida in the maintenance of structures until 1969. He then went to work for Metal Weld Company in Philadelphia, where he was in charge of shop operations, including coatings on metal tanks. Usually these coatings were epoxy formulations. In August 1970, he went to work for Oliver B. Cannon Company as Production Manager.

He stated that he has given lectures on the topic of corrosion to various groups. Some of these lectures have been published in technical magazines and distributed to those attending the lectures. He has worked on a number of jobs including electric plants, paper plants, and other projects where epoxy coatings were used. He stated that International Paper Company had utilized a two-component epoxy system quite similar to the Newport system. He first saw the Newport Bridge early in the spring of 1971. The contract for painting

had already been awarded to Cannon. Mr. Pinney came to the bridge for the purpose of organizing the job. Under the contract Cannon was to blast with abrasive material all corroded areas and loose paint. Its employees were to brush or sweep blast other areas to apply a top coat. This would disclose the paint which was loose, but not visible in its looseness to the naked eye. On this occasion, Mr. Pinney inspected the suspended portions of the bridge which constituted Phase I of the remedial painting work. They started with panel point 0′ and worked west to panel point 35′. Mr. Pinney hired scaffolding and other equipment such as paint hoses, air hoses, spray guns and the like. The job superintendent, Herb Holland, hired local workmen as well as utilizing regular Cannon employees. Mr. Pinney was not involved with the procurement of paint. This was the responsibility of the project manager. Cannon employees used polygrit as an abrasive.

Initially, Mr. Pinney was of the opinion that they would have to remove 35 to 40 per cent of the paint on the bridge. Cannon employees were to blast to a commercial standard of SSPC No. 6. However, he stated that as soon as they began blasting, they found they could not achieve stopping points. As workmen blasted one area, paint on the adjacent areas would loosen. It was hard to find sound, well-adhered areas of paint. This indicated that Cannon had been wrong on the scope of the work. Its workmen were taking off 80 to 90 per cent of the paint previously applied. Trying to save 10 per cent of the painted areas was not economically feasible. Consequently, representatives of Cannon conferred with representatives of the engineer and finally decided to strip off all the paint on members where defects existed. Thus, even on the gusset plates where some rust was found, Cannon workmen took off all the paint and redid the job. A few gusset plates were left entirely untouched, but most were redone.

He stated that a blast nozzle generates pressure from 90 to 100 pounds per square inch at the nozzle. A compressor maintained pressure of 100 to 115 pounds per square inch. This pressure was reduced by the length of the hose line. He further stated it was the aim of Cannon employees to provide an anchor pattern of paint 2½ to 3 mils in thickness for its prime or bottom coat.

He stated that a number of working days were lost due to fog and moisture having gathered on the steel surface. Each painter received a 20 hour minimum compensation, but otherwise the painter was paid when he actually worked. About 55 per cent of working days during a season were lost due to weather conditions.

After blasting, Cannon employees began brush striping of edges, but this was very time consuming, so that Cannon obtained a variance from the engineers in order to be permitted to do striping with a spray gun.

Mr. Pinney took thickness readings in order to check on the performance of his personnel. The prime coat was put on to the greatest degree of thickness in order to cover peaks and valleys. Mr. Pinney stated that he generally found an average thickness of 7½ to 8 mils for all three coats. His readings ranged from 5½ to 10 mils overall. Where he found thin readings, additional top coat material was added toward the end of the season. 20 to 30 per cent of the area repainted received such additional coat.

Toward the end of August 1971, Hurricane Doria came through the Newport area and damaged portions of the paint work which had been primed. It therefore became necessary to remove salt deposits before applying the next coat. Cannon employees used steam cleaning and finally brush blasting was necessary to remove all of the salt deposits.

Mr. Pinney had no contact with the remedial painting work in the 1972 and '73 seasons.

On cross-examination, Mr. Pinney stated that one of the AUTHORITY members had objected on the ground that paint was being applied to a greater thickness than specifications required. He also stated that after Hurricane Doria, some pinpoint rusting occurred where the prime coat did not cover all of the peaks in the steel. An acid wash was used to neutralize the pinpoint rusting. This was effective only in minor areas.

The next witness was Robert B. Roth of Bryn Mawr, Pennsylvania, who was President of Oliver B. Cannon, Inc. He was a graduate of Yale University in Civil Engineering and is a member of the National Association of Corrosion Engineers. He is a member of the Technical Association of the Bulk and Paper Industry and had instructed at the Liberty Bell Corrosion Course at Drexel University.

He stated that the Cannon firm is engaged in the field of application of protective coatings to steel, concrete and other materials for industrial and commercial structures. It is licensed in 38 states and has offices from coast to coast, but concentrates its efforts more along the Atlantic and Gulf seaboards. Mr. Roth stated that he has been with Cannon since graduation from Yale in 1946. He has worked in the Estimating Department from 1947 to 1955, during which he participated in estimating more than 1200 projects. In 1956 he was promoted to Executive Vice President of the firm and served in this capacity until 1971, when he was appointed as President. During his service as Executive Vice President and President he supervised and managed many jobs and assisted in the preparation of articles and publications concerning the preparation and application of paint.

He worked on a Pennsylvania Railroad bridge, a bridge across the Susquehanna River and also on a number of smaller bridges, and a number of paper and unloading facilities. He worked on epoxy coatings beginning during the 1950's.

The Cannon firm helped to pioneer the use and application of epoxy coatings. During the years 1961 and '62, Cannon applied more epoxies than its competitors. Epoxies were used particularly where industrial processing caused the element of corrosion to be important. Mr. Roth participated in using epoxy coatings for eight paper and pulp mills. He painted three power plants for Potomac Electric Power Company with epoxy coatings. He also did three nuclear generating stations for Philadelphia Electric Company as well as three cement manufacturing facilities. Also four fossil generating plants were covered in part with epoxy coatings for Stone & Webster. He stated that he was Project Manager for about 70 per cent of the long list of Cannon projects set forth in Plaintiff's Exhibit No. 90. These projects were spread throughout the country.

Mr. Roth testified that he was approached by Mr. Zecher of PARSONS, but prior thereto had had no contact with this engineering firm. He was reluctant to participate in this project because he had a policy not to deal with public or governmental bodies. After being told by Mr. Zecher that Cannon had been recommended by International Paper Company, Mr. Roth reviewed the specifications and inspected the Newport Bridge December 1, 1970.

He noted visually that the paint had failed. Extensive peeling and loosening of paint from the substrate was evident. As he walked over the bridge he took representative samples of paint chips. He later looked through the plans and drawings of the bridge.

The engineers had divided the remedial painting work into four phases. The paint specifications provided for a two-component epoxy paint of the catalyzed polyamide type. Mr. Roth had worked before with epoxy coating of this type, as well as with other types of epoxy coating. The system specified for the Newport Bridge was the most popular of the epoxy coatings.

Upon his inspection, Mr. Roth was of the opinion that 35 to 40 per cent of the paint had failed in the suspended span area which was denominated Phase I. In the area of Phase II it also appeared that 35 to 40 per cent of the paint had failed. Phases III and IV areas appeared to be in better shape. On the basis of these observations an estimate of square footage, labor, equipment and material costs was prepared for budget purposes. This estimate was presented in the form of a proposal on December 21, 1970. Meetings with the engineers followed. Ultimately the proposal was accepted and a contract was signed February 16, 1971.

Cannon employees were to proceed in accordance with the specifications, removing bad paint with commercial sand blast equipment and repainting the areas from which paint had been removed. Where paint had not wholly failed, Cannon employees were to use a brush or sweep blast to check the extent of failure and to roughen the surface for application of a new top coat.

Mr. Roth conferred with Mr. Zecher concerning the procurement of paint. Mr. Roth suggested a list of the most responsible vendors. Some of these were visited by Mr. Roth and Mr. Zecher. M. A. Bruder Company ultimately became the supplier. Mr. Roth and Mr. Zecher had visited the plant and reviewed its Philadelphia facilities. The specifications for this plant were identical to those used for the initial application in Contract No. 3. Batch samples were sent to a testing laboratory.

Once the remedial painting project began, Mr. Roth made visits to the job once per month or more frequently. During the 1971 painting season, about 40 per cent of Phase I was accomplished. This cost $965,000 rather than $750,000, which had been estimated as to the total cost of Phase I.

In actual practice the job superintendent complained that a great many of the adjacent areas turned out to be bad. Mr.

Roth visited the bridge on May 6, 1971 and found the extent of failure was well beyond that which he had visually observed. He looked at paint chips and saw what he believed to be mill scale underneath. He observed the extent of corrosion. He then concluded that the paint failure on this structure approached 100 per cent. This meant that the number of man hours for the most expensive part of the operation, namely, removal of paint, had to be greatly increased. It was also necessary that the scope of repainting had to be correspondingly increased.

Cannon employees returned to the job in 1972 and the contract was modified. The Cannon firm again returned in 1973 and the contract as modified was renewed. There was no contract to return in 1974. Mr. Roth stated that the contract was in suspension, but not terminated. He stated that the Phase II area consisting of the east truss portion required considerable work. He estimated that 85 per cent of the coating needs to be removed. His estimate as to the cost of this work was in the sum of $1,134,000. He buttressed this estimate with detailed statements of the amount needed for labor, materials, equipment, supervision and the like.

He estimated that for Phase III, the west truss areas, 80 per cent of the paint coating would have to be redone at a cost of $663,400.

He stated that on the basis of a recent inspection of the Phase IV area, he estimated a lesser percentage of work to be required. Taking into account labor, materials, equipment, supervision and other expenses, it was his opinion that the Phase IV work would total $320,179.

Mr. Roth testified that Cannon had received from the AUTHORITY for remedial work from the inception of the program to the date of his testimony the sum of $2,342,370.63.

On cross-examination, Mr. Roth stated that he had utilized prior epoxy coatings which were similar to the Newport Bridge system, although the pigments were different.

He stated that the paint on the towers looked all right, the plate girders seemed to be in good shape and some of the structures above the catwalk seemed visually all right in respect to paint coating.

He stated that he had perceived the mill scale on the chips of paint which he had observed. He stated that he recognized the mill scale visually. This was the element which prevented the paint from adhering to the bridge, in Mr. Roth's opinion. Thereupon counsel submitted 15 envelopes to Mr. Roth containing paint chips. On most of these he stated that he could not determine whether there was mill scale on the chip or not. He stated that the samples were too small and that some of them were mere powders and could not be identified. Mr. Roth stated that some chips had the appearance of scale or mill scale adhering thereto, but he could not be sure without further information. He stated that mill scale will deteriorate and turn to rust when exposed. Mr. Roth stated that all corrosion is electrochemical in nature.

On redirect examination, Mr. Roth testified that the charges which Cannon had made to the AUTHORITY are fair and reasonable. He stated that the work to be performed on Phase II is reasonably necessary in order to protect the steel. He testified that his cost estimate was fair and reasonable. He testified that the work to be performed on Phases III and IV is also reasonably necessary and the cost estimates in respect thereto are fair and reasonable. He testified that the cost of access to this work has increased enormously because of new OSCHA scaffolding standards.

The next witness was Sidney B. Levinson, who was recalled for the purpose of redirect testimony. He testified that the version of the George B. Heckel Award which he received was for papers submitted to the Society for Paint Technology. It was definitely established that the award which he received was not the same as the major George B. Heckel

Award given annually for outstanding service to the paint industry.

The next witness was Mr. Saul Spindel, who was recalled for the purpose of cross-examination. Mr. Spindel testified that he had used four paint systems as well as the Newport system. These systems were as follows: (1) SSPC (Steel Structures Painting Council). (2) AASHO (American Association of State Highway Officials). (3) International. (4) Enjay zinc chromate epoxy.

The SSPC and AASHO systems were not epoxy systems. The International and Enjay systems were epoxy systems. The salt fog tests were used to test accelerated corrosive effects upon these paint systems.

There are people in the paint industry who will accept the salt fog tests and those who will not accept them. Some individuals rely only upon service tests in the field. Mr. Spindel testified on cross-examination that one of the advantages of the salt fog tests is time. In some instances one cannot wait two or three years for the outcome of a field test. Consequently, the accelerated laboratory salt fog test is desirable to be used.

He further testified that all systems utilized were in the same range of film thickness. The paints were applied by spray and then smoothed out gently with a brush in order to eliminate sag, dimpling, and to achieve a uniform thickness. He stated that the wetness characteristics of an epoxy coating are less desirable than those of a linseed oil paint. However, the method of application used by Mr. Spindel's assistants with a brush would make this difference of no material importance. Using a brush around the bolt heads improved the wetting characteristics of the epoxy coating and would also put the paint on the surface more effectively. He testified concerning physical characteristics such as sagging. He described the office of solvent in paint and stated that it is

not part of the residual product which protects the surface. The pigment plus the vehicle makes up the residual product. He stated that all solids are components of paint in order to inhibit corrosion and to cause the paint to perform as a protective coating. He stated that in order to vary corrosion resistant characteristics, one may vary the pigment and vehicle volume. Mr. Spindel testified that the first set of sample channels which were utilized for his testing had been blast cleaned to a No. 10 level, which was near white and well above the level required for commercial blast purposes. Thereafter, a second set of samples were prepared which have been submitted into evidence.

The next witness was Dr. Kenneth H. Mairs of South Kingstown, Rhode Island, who is a Professor of Metallurgy at the University of Rhode Island. He also acts as a consultant and expert in the field of metallurgy from time to time. He also serves as a metallurgical investigator for the University of Rhode Island Criminal Laboratories. He holds a Bachelor of Science and Master of Science Degree from Penn State University. He has been qualified as a metallurgical engineer at Penn State in 1950. In 1957 and '58, he worked for the Atomic Energy Commission. He has served at the RCA Laboratory as a research metallurgist. He was also employed at American Cyanamid Company performing technical services in metal. He also saw service at the Naval Torpedo Station as a metallurgist and later as chief chemist. He belongs to a number of professional societies of mining and metallurgical engineers and is a member of the Rhode Island Chapter of the American Society of Metals.

Professor Mairs testified that he was contacted February 14, 1974, by Mr. Dolan concerning the paint problem of the Newport Bridge. A meeting was arranged with Mr. Hogan, Mr. Zecher, Mr. Dolan and other interested persons. Professor Mairs looked at a number of paint chips and material on

the other side of such chips. He examined these samples visually, with a magnifying glass, and then performed magnetic tests. He was asked whether one could distinguish mill scale and rust. Professor Mairs stated that he thought this could be done by x-ray diffraction testing.

He stated that mill scale is typically produced at high temperatures and contains typical iron oxides produced at high temperatures whereas rust contains oxides produced at low or ambient temperatures. He testified that heavy mill scale has a tendency to break into layers. He stated that there should be a great deal of FeO in iron oxides. Mr. Buschbom brought 63 samples of paint chips to the Mairs laboratory. Professor Mairs retained 21 of the samples which formed the best bases for examination. Some of these samples had a blue-black substance and adjacent thereto were reddish-brown substances. He subjected the blue-black area to x-ray diffraction and determined the presence of Fe_3O_4 or magnetite. The reddish-brown areas under x-ray diffraction showed FeOOH. This is the first ferric form of iron corrosion. It is a hydrated oxide. Professor Mairs did not find FeO. This would have simplified the problem and it would have ended his examination there.

Professor Mairs went to the Newport Bridge February 19, 1974 to Pier 4E in the east truss area. The paint was horribly cracked and broken. It needed restoration badly. At this area he took 11 samples. He examined 4 of these samples under x-ray diffraction. He did not find FeO but found extensive rusting under the paint. There was a quantity of FeOOH or oxidized products. He stated that the end product of corrosion is usually Fe_3O_4. Also, Fe_3O_4 may be a mill scale product, formed at high temperatures. The structure of the peaks of the diffraction graphs are different. These peaks could not be made to look the same at temperatures less than 1,000 to 1500°. Thus the structures of the peaks can be distinguished.

Professor Mairs took a sample piece of hot rolled strip steel. From this he made a pattern of typical mill scale profiles. FeO was by far the predominant oxide. Also there was Fe_3O_4 or magnetite present as evidenced by tall peaks. He stated that the more massive bridge structural forms would cool much more slowly than his sample strip. He heated the strip to 1600° and then allowed it to cool slowly within the furnace. He found that the slowly-cooled material had more mill scale than the quickly-cooled strip. Also the mill scale was not as tightly adhered to the steel where it slowly cooled as it was on the quick-cooled sample. After cooling slowly, Professor Mairs found Fe_3O_4 was the dominant material and FeO was in more limited quantity. He then testified in detail as to the specific samples upon which he performed his tests. He emphasized on the basis of all of these tests that the quantity of FeO is much less in the slow-cooling sample than in the fast-cooling sample.

He stated that FeO was not found on the paint chip samples from the Newport Bridge. This merely indicated that FeO did not adhere to the paint. It either stayed with the steel or disappeared altogether, since it is an unstable substance which will oxidize in the air to FeOOH. This change in character will occur in a short time and will be accelerated by the presence of water either as vapor or liquid. Professor Mairs stated that the patterns which he observed in his diffraction tests indicated that the blue-black materials were the outer portions of mill scale. He stated that the red-brown substances are also mill scale stained by FeOOH components. This suggested to Professor Mairs that where blue-black and red-brown oxides are found, the mill scale was not removed prior to painting. He asserted that the blue-black areas on the big paint chip (Plaintiff's Exhibit No. 122) were relatively massive crystalline formations of mill scale. Of the 21 samples examined, Mairs found one third to have decidedly blue-black areas. He

would therefore conclude that one third of the 63 samples had blue-black areas as well. After further examination, he revised his estimate to say that out of 21 samples which he analyzed, 18 contained blue-black or red-brown areas, indicating the presence of mill scale. His prior estimate of 7 out of 21 he determined to be unreasonably low. Thereupon he checked a number of other samples taken at random and found blue-black areas on nearly all of them.

On cross-examination Professor Mairs stated that the size of the particles would make no difference in determining the crystalline material present or its characteristics. He stated that Mr. Dolan asked him to come to Providence, and Professor Mairs stated that he would do so. The next day he and the attorneys talked for four and a half hours about the technical problem of distinguishing mill scale from rust or corrosion. He stated that mill scale produced by the steel manufacturing operation is blue-black in color, hard and sharp. It will cut one's fingers. It is formed not by the rolling operation but as the metal cools afterward. A wheelabrator is used to eliminate mill scale from the structural shapes. It blasts the steel free of mill scale if working properly. If mill scale is not all removed, it can be seen as the steel comes out of the machine. He stated that none of the paint chips had FeO on them. He further stated that the unstable FeO may change into Fe_3O_4 as it cools or afterward. This change may be affected by environmental conditions such as a severe marine environment. He stated that FeO becomes Fe_3O_4 at 1,000° as it cools. Once it cools to room temperature it doesn't convert; it rusts. He stated that the absence of Fe_2O_3, which is the highest form of iron oxide and sometimes referred to as hematite, was insignificant, since its content in mill scale will ordinarily be too small to have significance on an x-ray diffraction test.

The next witness was Mr. John W. Kinney, who was deceased at the time of trial, and therefore his testimony was

introduced by deposition. Mr. Kinney resided in Weehawken, New Jersey at the time of his deposition and was employed by PARSONS as Resident Engineer on the 63rd Street Tunnel project. Prior thereto he served as Resident Engineer at the Newport Project from March 1965 until December 1969. Mr. Kinney was a graduate of Stevens Institute of Technology with a degree in Mechanical Engineering in 1925. He was employed by various contractors on heavy construction work from 1925 to 1953. Included in this experience was a considerable amount of bridge construction, highway construction and viaduct construction. He worked as Resident Engineer on the Mackinac Bridge and also the Verrazano Narrows Bridge. Thereafter he went to work for PARSONS at Newport.

From June or July of 1965, Mr. Kinney established a residence in Newport and maintained it until December 1969. As Resident Engineer it was his duty to represent PARSONS, to see that all specifications were complied with, to oversee inspection and to supervise the preparation of estimates and reports to be submitted to PARSONS and to the AUTHORITY. His staff included a Chief Paint Inspector who at times functioned alone and at times had two or three men to assist him. When there were problems with paint, they were reported to Kinney, who observed conditions and, if necessary, would call a meeting of BETHLEHEM and PARSONS higher-up representatives.

Mr. Kinney had no prior contact with epoxy coatings, but had experience with a good many other types of paint systems. On this job, the field painting was limited to splice connections and touch-up of damaged or inferior applications of shop coats of paint. There was damage noted from handling and shipping of the steel. Some parts arrived on the job in bad condition. Corrections were made by blasting and renewing the paint.

Mr. Kinney also noted deterioration in the paint while he was on the job. On occasion he noted deficient film thickness, paint which had been applied over grit and paint which had been imbedded with cinders and foot prints. He also noted holidays and deficient paint thicknesses. These conditions were corrected in the field.

During the project, BETHLEHEM asked for and received permission to use Intergard zinc-rich epoxy paint for a field-applied primer in order to speed up the job. This paint was used on splice plates and other portions which had not been painted in the shop. Mr. Kinney was not too sure of the advantage of the use of this paint, but BETHLEHEM claimed it was necessary in order to finish the job on time. It was suggested that this paint was easier to apply.

Mr. Kinney stated that he had inspected and tentatively accepted three west rows of girder spans. He noted that grit was imbedded in the shop coat, but at that time it wasn't thought to be serious and therefore the retainage sum was paid.

He also noted damage to paint on the edges of the structural steel where it had been handled with steel cable slings. The edge damage was progressive as much as an inch inward from the edge and a foot along the edge. These conditions were corrected sometimes in the storage area and sometimes after erection on the bridge site.

Toward the end of Mr. Kinney's service at Newport, he noted that large areas of paint could be peeled off right down to the substrate of the steel. This occurred fairly generally on the suspended span portion of the bridge. These were shop-painted structures. Under the peeled paint, he noted corrosion and sometimes mill scale, and also sometimes he noted grit.

The next witness was Sidney Zecher, who was recalled. He stated that the remedial painting would take approximately

three seasons to complete and would require approximately $250,000 in engineering expenses. He stated that the total sum paid to BETHLEHEM up to December 31, 1970 was $18,958,060.88. There was a total sum due of $19,763,057.43 under the contract and including change orders. Therefore, the sum of $804,996.55 was the balance due under the contract including change orders, some of which had not been finalized at that date.

On cross-examination Mr. Zecher stated that of the $232,000 costs incurred for inspection and supervision by PARSONS on the Cannon paint job, the sum of $212,872.54 was actually billed to the AUTHORITY.

The next witness was Mr. John J. Gill of Cranston, who was serving as Chairman of the Rhode Island Turnpike & Bridge Authority. He testified that he had been a member since 1956 and succeeded Mr. Dwyer as Chairman. He stated that the AUTHORITY has no plans to carry out remedial painting during the 1974 season, because of lack of funds.

At this point the plaintiff rested and the defendants' case began. The first witness for the defendant was Mr. Valentino J. Assetto of Bethlehem, Pennsylvania, who was employed by BETHLEHEM since 1949. He serves as the Construction Manager for BETHLEHEM. He graduated in 1949 from Lehigh University with a Bachelor of Science degree. His experience with BETHLEHEM included management training, structural fabrication, engineering department, design and cost estimating of bridges, bridge erection on site and railroad bridges. He served as Regional Project Manager for California, Washington and Oregon projects. He performed the scheme engineering for erection of a bridge spanning the Mississippi River from Davenport, Iowa to Moline, Illinois. He has had extensive experience in field cost estimating and special project supervision at the home office. He has coordinated the preparation of bids from the home office on a

number of projects including the Newport Bridge. He worked on the estimating of costs for the field painting of the Newport Bridge. He solicited bids from subcontractors for painting work which would be carried out by them, not by BETHLEHEM. This was done through BETHLEHEM'S Purchasing Department. He solicited three bids on the Newport job which included the two main towers, cable bents, cables, suspended span and the exposed portions of the anchors. The bids did not include welded stringers or plate girder spans on the east and west ends of the bridge. The scope of the work included touch-up of unpainted shop material. At this point in time the shop painting was to include the primer coat only. Mr. Assetto estimated the cost of painting at $59 per ton for structural steel.

The March 16, 1966 bid date was cancelled. The next day Mr. Assetto attended a meeting at PARSONS. This meeting was called to discuss ways of reducing the cost of the project. A number of BETHLEHEM representatives including the witness as well as Messrs. Hedefine, White and Mandel of PARSONS were present. Mr. Hedefine chaired the meeting and explained the need for changes to effect economies. One suggestion was to make the approaches and the suspended span part of one package. They also discussed the handling of the concrete deck as a separate contract. They talked about paint as well. Messrs. Hedefine and White stated that they wouldn't consider changing the paint system.

The project was then readvertised for bid for a changed scope of work. All structural steel items were in the new bid, including approaches as well as the suspended span. The median traffic barrier was removed. There was no change in the paint system. However, the new documents did provide for shop application of the second and third coats of paint at the option of the contractor.

On April 21, Mr. Assetto submitted a proposal to the AUTHORITY. This included a revised estimate on painting based on applying all three coats in the shop, except for certain contract areas such as gusset plates which were to be left unpainted. The witness identified and there was introduced into evidence a summary of erection cost estimates dated April 15, 1966, which was marked as Defendants' Exhibit No. 30. The painting costs in this estimate were based upon a figure of $20 per ton. This in turn was based upon the application of three coats of paint in the shop, with only touch-up painting to be done in the field. Under Assetto's estimates, the total paint costs would amount to just under $400,000. In his opinion, the estimate of $20 per ton was a fair and reasonable cost for paint. Thereafter, he solicited bids for painting and received three bids including that of Conomos in the sum of $459,000. He accepted the Conomos bid. The subcontract entered into was actually a cost plus, a fixed fee type of contract. This arrangement was entered into because the application of three coats of paint in the shop was rather unusual in the eastern area. Mr. Assetto felt the lump sum bid by Conomos was too high and that the cost plus arrangement would be the most economical. Mr. Assetto felt that Conomos was best qualified to do the work.

On cross-examination Mr. Assetto stated that he and his associates did not question the PARSONS paint specifications. PARSONS was a topflight bridge engineering firm. The subcontractors also assumed that they could put the epoxy paint on as they would any other system. They considered possibly that it would cost more per ton for the total paint job. Mr. Assetto had never previously estimated the field cost of applying an epoxy paint system. He had never estimated a job where three coats would be applied in the shop and three field coats would be applied to certain contact surfaces.

In further cross-examination by Mr. Dolan, Mr. Assetto said that he consulted the ship building division of BETHLEHEM which had had experience with epoxy paint systems. The BETHLEHEM bid was made without pre-bid procurement inquiry on field painting. The initial proposal by Conomos amounted to approximately $59 per ton. He stated that Conomos may have done some corrective work on the tower cells but did no corrective work under this contract to correct errors committed in the shop.

The next witness was Seymour C. ("Ben") Frye. At the time of his testimony he was retired but had been employed by BETHLEEM for 27 years. His last employment was as Manager of the Coating and Corrosion Prevention Laboratories. He had received a Bachelor of Science in Chemical Engineering from Drexel University in 1930. He had been employed by DuPont at its Quality Control Laboratory relative to paints and varnishes at Philadelphia for 16 years. He then went to BETHLEHEM where he was employed as a Research Engineer in Coatings and Corrosion Prevention, as a Staff Engineer relating to Organic Coatings and as a Section Supervisor of Organic Coatings and Corrosion Prevention.

Mr. Frye was a member and past director of the Society of Corrosion Engineers, a member of the Steel Structures Painting Council and of various societies in the paint and coating field.

He stated that he met Mr. Bradley while both men were employed by DuPont. Bradley was employed as a salesman. He and Bradley both attended meetings of the Steel Structures Painting Council.

On December 16, 1965, Mr. Frye had a discussion with Mr. White of PARSONS concerning the Newport project. Prior to this conversation, Mr. Frye did not know Mr. White or anyone in the PARSONS firm. Mr. Frye was called to Mr.

Spilman's office and was told that he was going to have a telephone conversation with Mr. White of the PARSONS firm. He didn't know where Mr. White was when the call was placed. He had not seen the specifications at this point. The conversation lasted about five minutes. During the conversation Mr. White asked about epoxy systems. Mr. Frye answered that they were good but hadn't been used on bridges. He also advanced the opinion that SP No. 6 grade cleaning would be adequate. They also discussed costs which Mr. Frye said were only ball park figures. They talked about chalking, pot life, durability and other characteristics. Mr. Frye stated that he did not recommend the epoxy system for use on the Newport Bridge to Mr. White or anyone. Mr. Frye had run no laboratory tests on this system. He was aware that such a system had not been previously used on bridges.

He knew that epoxies had been used on ships below the water line by BETHLEHEM under the supervision of the manufacturers of the paint. These coatings were usually 8 to 14 mils thick below the water line. Because these epoxies were proprietary substances, Mr. Frye made no effort to break them down into their component parts.

He stated that Mr. Bradley had described his glass flake paint system. Mr. Frye had performed a test on this paint in order to consider its usefulness on H piles. At Bradley's insistence, a piling was coated with glass flake and allowed to remain until December 1970. This test was underway in 1965.

In cross-examination by Mr. Dolan, Mr. Frye stated that the Homer Laboratories were a part of BETHLEHEM'S research division. These laboratories were primarily a service group dealing with paint. In 1965 and 1966 Mr. Frye was a specialist in paint and coatings for steel. BETHLEHEM itself had about 14 sets of specifications for paint, of which Mr. Frye had written some.

He stated that epoxies first came into use about 1950. The manufacturers included Devoe, Mobil and Sherwin-Williams, as well as other companies. He stated that BETHLEHEM had previously used epoxies on the boot-topping areas of a ship between the low and high load lines in the area of the plimsoll mark. He stated this is the most severe marine environment except for pilings where the area between high and low water marks are alternately covered and uncovered.

Mr. Frye stated that he had known Bradley for about 30 years in 1965, that he saw him about three to four times a year. He stated that Mr. Bradley would come to see him and discuss paint, primarily paints which Bradley was trying to promote.

Mr. Frye stated that he was capable of determining the adequacy or inadequacy of paint specifications. He didn't have to rely upon anyone to make such a determination. He conceded that on February 25, 1966, after studying the specifications for Newport, he declared that they were satisfactory. He does not recall recommending an epoxy system as he is quoted as doing in White's memorandum (Plaintiff's Exhibit No. 38), but does recall answering 18 questions as he is quoted as doing in the same memorandum.

He stated that he had tested the Armstrong formulation of epoxy coating in order to check its spray qualities and certain other application attributes.

He discussed the specifications with Mr. Bradley in early January 1966. He wrote a memo to Mr. Jameson January 10, 1966, indicating that he had reviewed the specifications before they were forwarded to Mr. White. He also stated that he recommended the striping of the edges either to Mr. Bradley or Mr. White. This recommendation was put into the specifications. He also participated in a conference at Pottstown where the SSPC No. 6 blast cleaning was done on sam-

ple steel panels to be used as standards, although pictorial standards were to be used as well.

He stated that the shop application of paint was new to BETHLEHEM. He recommended the size of the shop but didn't have anyting to do with setting it up. In June 1966, there had been a Chicago demonstration of the paint before the first Pottstown meeting. There was also a second Pottstown meeting at the shop. Mr. Frye testified that Mr. Fine was Supervisor of Quality Control at the Pottstown Plant. He stated that Mr. Fine was alive, but Mr. Hynes indicated that Mr. Fine was not well. Mr. Frye testified that BETHLEHEM had trouble with a Rotoblast machine used in their painting program. He checked and found that mill scale was not being removed on the first time through the machine.

He further stated that there was no indication of any deficiency in the paint system prior to 1970. He would not dispute that the first indication of deficiency in the paint system as such was presented in a report from Arthur D. Little, Inc. Mr. Frye was not working at that time. He had retired. Mr. Frye testified on redirect examination that the Steel Structures Painting Council has recently issued a tentative set of specifications for an epoxy paint system. This council has been considering these specifications since 1964 and has still given only tentative approval. Mr. Frye further stated that the Pangborn blasting machine would certainly clean steel to an SSPC No. 6 grade or better. It simply took more than one pass through the machine to accomplish this.

Mr. Frye stated that if he had been asked to run tests on the proposed epoxy system, he would have done so. Such tests would have included an exposure test for a minimum of five years. At the Pottstown plant Mr. Frye noticed certain defective paint on castings. These castings were repainted in the field and so far as Mr. Frye knows, have not been repainted since by Cannon or anyone.

The next witness was Robert F. Tevelson of Pottstown, Pennsylvania, employed by BETHLEHEM on and off for more than 21 years. He had received a Bachelor of Arts degree in Civil Engineering from the University of Pennsylvania. He had also studied at Biarritz University in France and at the Graduate School of the University of Pennsylvania. He had also taken courses in data processing science. Mr. Tevelson had a varied career at BETHLEHEM beginning with a management training course in 1949. He worked at the Pottstown Works as Shop Engineer. He left in 1954 to work for the Delaware Steel Company as Chief Engineer. After working for other engineering firms, he returned to BETHLEHEM in July 1957 as Shop Engineer. After serving in various grades he became Superintendent of Shop No. 1 of the Pottstown plant where he supervised fabrication of structural steel, including painting from 1966 to 1968. From 1968 to 1972 he served as Assistant Manager of the works, in which he was responsible for overall coordination of shops, safety and industrial engineering. In December 1972, he became Manager of the works, responsible for quality control, safety and the overall operation of the BETHLEHEM works at Pottstown, including production of structural steel for bridges, buildings and other structures. He has been involved in numerous major construction projects of big buildings, power plants, shopping malls, bridges, highways and arenas.

He stated that the Pottstown Works are on 100 acres of land. There are two prime shops of which Shop No. 2 does bridge work and Shop No. 3 does work on building materials. These works include an assembly plant 1500 feet long. At the works they produced fabricated steel for the Newport Bridge from July or August of 1966 to January or February 1969. From November of 1966 to January of 1969 the painting of the steel took place. A Wheelabrator was installed at Potts-

town and was made operable in June 1966. It had been used on one job prior to the Newport job. The Wheelabrator building was located in the northwest corner of Shop No. 2. It was 51 feet by 250 feet in size. It was used just for the Wheelabrator. The overhead cranes serviced the steel going in or coming out. There were also roller conveyors which could be regulated as to velocity of movement for the steel. He described the operations of this Wheelabrator wherein wheels within the cabinet threw abrasive shot upon the material. Adjacent to the conveyor were railroad tracks for bringing in and taking away material to be cleaned. This material could be passed through the machine more than once. The Wheelabrator was used to clean plates and structural materials.

In addition to the Wheelabrator there were unusual blasting operations and a Rotoblast device. The Rotoblaster was located in the northwest extension of Shop No. 1. This became available for use about August of 1967. This was a Pangborn Rotoblast machine.

The Rotoblast was more versatile in handling irregular shapes. An endless chain was used to move materials through the cabinet.

He stated that material received from the mill was first stored, then pre-blasted. As received from the mill, there was blue-gray mill scale, rust and other foreign material such as dirt on the steel. He stated that during the Newport Bridge period, inspectors from Pittsburgh Testing Laboratories retained by the AUTHORITY were present at all times. He stated that the inspectors varied in numbers from two to ten according to the volume of the work and the number of shifts. He stated that inspection tags were fixed to members after cleaning and before painting. The Pottstown plant produced 10,200 pieces for the Newport Bridge. After cleaning, the structural members were stored and inspected for commer-

cial blast cleaning and for smoothness of surface. This inspection was made by BETHLEHEM personnel. Then, Pittsburgh Testing Laboratories inspectors were contacted and if both agreed, yellow tags were attached approving the member for painting. Thereafter, the painters when the temperature was appropriate would apply the first coat and note of temperature. It was the procedure to attach such a tag to each member before painting.

After the first coat, a thickness test was made by BETHLEHEM and Pittsburgh Testing Laboratories inspectors. This same process was followed after each coat and after the final coat. Then Pittsburgh inspectors would attach a red inspection tag which was on the members when they were loaded upon railroad cars. The steel was inspected for weld, smoothness of surface, shot imbedded in the steel or other imperfections. The witness introduced inspection reports of Pittsburgh Testing Laboratories beginning November 4, 1966 and extending to 1969 as Defendants' Exhibit No. 38. He stated that none of the foregoing reports indicated a rejection of any steel because of mill scale.

On cross-examination Mr. Tevelson stated that the yellow tag was a BETHLEHEM tag. There was no reference on this tag to blast cleaning. Many of the yellow tags introduced into evidence as Defendants' Exhibit No. 37 did not have the initials of an outside inspector. All of the tags produced related to portions of the bridge other than the suspended spans. The bundle of reports introduced related to the paint job, not to the blast cleaning of the steel. He stated that a specimen or model of an SSPC No. 6 blast-cleaned piece of steel was sent to each of the five blast-cleaning locations. He further stated that the Rotoblast machine became available in August of 1967, not in January as indicated in correspondence. He stated that some mill scale would remain on material which had been post-blasted in the Rotoblaster where no pre-blast had been applied, even after five or six pass-throughs of the

steel. All of the structural steel rolled members were generally pre-blasted in the Wheelabrator.

From August 1967 adjustments were made to the wheels in the Pangborn Rotoblast by both BETHLEHEM and Pangborn personnel in order to achieve better angles for shooting the blasting shot. BETHLEHEM complained that the Rotoblast machine was not as effective or as efficient as had been claimed by the manufacturer.

Mr. Tevelson testified that prior to the Newport job, he had no experience with epoxy paint systems. He had only two other jobs where it was required to clean steel to the SSPC No. 6 standard. The Pottstown plant was not set up for a big blasting operation prior to the Newport job. They did have, prior to this time, two portable blasting units.

On redirect examination, Mr. Tevelson testified that BETHLEHEM workmen never deliberately refrained from sending structural shapes through the blaster a sufficient number of times to clean them in order to save money. To keep production going at a peak, BETHLEHEM workmen sometimes used the Wheelabrator as well as the Rotoblaster for post-blasting operations. The problems with the Rotoblaster were all production problems, not problems relating to the ability of the machine to do the job.

The next witness was Alfred Hedefine of Sparta, New Jersey, who was employed as Senior Vice President of PARSONS. He stated that the partnership had transferred to a corporate form some years ago. He served as the partner in charge of the Newport Bridge project. He stated that he had received a Bachelor of Arts in Civil Engineering from Rutgers University and a Master's Degree in Civil Engineering from the University of Illinois in 1931. He received a professional degree as a civil engineer and has served with one other consulting engineering firm in addition to PARSONS.

He stated that PARSONS performed varied types of engineering work on heavy structures, highways, water supply installations, railroads, power plants and other types of heavy construction. He stated that he first served as a designer, then as an associate, then as head of the Structural Department for PARSONS. Thereafter he served as a partner who would take full responsibility for a project. He was engaged in engineering work on a number of bridges, some of them monumental in size.

He stated that feasibility studies on the Newport Bridge went back as far as the 1940's. About 1959 or 1960 the feasibility studies ended and the design work began. The design work was done in the structural division. The force in that division would vary from five men up to thirty, depending on the work load at a given time. The engineering contract with the AUTHORITY included design and supervision of construction. Also PARSONS prepared specifications for the Pittsburgh Testing Laboratories contracts. Various firms bid for this testing job.

The selection of the paint system occurred during 1965. He stated that no lab tests were conducted in respect to the epoxy paint system by PARSONS prior to preparation of the bid documents. He stated that no field tests were conducted by PARSONS. The basic information was derived from manufacturers. Mr. Hedefine did not know if field tests were carried out by others. Mr. Hedefine knew of the application of epoxy paint systems to other structures through Mr. Bradley and Mr. White. He stated that the same system had been used on the Ticonderoga plant of International Paper Company and in several plants on the Gulf Coast. He stated that prior to the Newport Bridge project PARSONS had not previously specified an epoxy paint system. However, they had knowledge based upon literature plus information supplied by Messrs. White and Bradley.

He stated that although he is a member of a number of engineering societies, he is not a member of the Steel Structures Painting Council.

He stated that he was looking for a paint coating system which would be better than red lead and linseed oil. In selecting the epoxy coating he considered the useful life as compared with the cost of application and maintenance. Taking these factors into account he considered the epoxy coating as an economical system.

The next witness was Dr. Edward T. Peters of Brookline, Massachusetts. He was employed by Arthur D. Little Company as a research scientist for the past five years. His education included a Bachelor of Arts degree from DePauw, a Master of Science from the University of Wisconsin and a Ph.D. from M.I.T. in 1963. His specialty was the determination of characteristics of substances through x-ray diffraction and microscopy. He is in the Materials Section and is employed as a metallurgist. His Master of Science degree was obtained in the field of metallurgy. He has done x-ray diffraction analyses for the past 15 years and does this on a daily basis. He has published several scientific articles relating to x-ray diffraction.

Dr. Peters carried out a scanning analysis of certain chips which Professor Mairs had previously tested. Dr. Peters used a linear scan on Phillips x-ray equipment. The resulting patterns were different in certain instances based upon the different types of radiation (chrome versus copper) utilized in the equipment and also the linear scale used in the Phillips equipment as opposed to the log scale used by Professor Mairs. Professor Mairs' stubby peaks indicated Fe_3O_4. Dr. Peters' peaks were sharper and indicated gamma FeOOH.

From his tests of the paint chips taken from the Newport Bridge, Dr. Peters concluded that there was no evidence of the presence of mill scale. He stated that mill scale would con-

tain FeO and probably Fe_2O_3. As to the samples which had been introduced by Professor Mairs he stated that one could not determine whether Fe_3O_4 or magnetite had been formed at high temperatures or low temperatures. He stated that the character of the peaks, whether sharp or stubby, has no relationship to the time of their formation. He found that the Fe_3O_4 peaks were no different on the reddish-brown material than they were on the blue-black material. He stated that FeO would not completely disappear where mill scale had initially been present.

On cross-examination he stated that mill scale is composed of FeO (wustite), Fe_3O_4 (magnetite) and Fe_2O_3 (hematite).

He stated that he is an expert in x-ray diffraction and a metallurgist. This was the first case in which he analyzed mill scale. He stated that in some instances the paint will adhere directly to the Fe_3O_4. He agreed that FeO is a nonstable substance which tends to oxidize into some other compound such as Fe_2O_3. However, he asserted that FeO may remain on the steel in this same form for many years. If one finds FeO, it is pretty certain that one has discovered mill scale. However, if one does not find FeO this is not conclusive proof that there is no mill scale.

In the text book mill scale is shown as consisting of three layers; FeO, Fe_3O_4 and Fe_2O_3, in that order. In practice this layering may be disrupted, but generally there would be a tendency toward such layering.

He was unable to state whether FeO would oxidize into Fe_3O_4 at ambient temperatures. He would not expect it to oxidize into FeOOH and thence intoFe_3O_4. He stated that in the presence of oxygen and air, FeO will oxidize into FeOOH and Fe_2O_3 and Fe_3O_4, but at room temperature this would take a long period of time. At high temperatures it would occur more rapidly.

In cross-examination by Mr. Dolan, Dr. Peters stated that Fe_2O_3 (hematite) is found only in minute quantities, approximately 2 per cent of the total. It would show on x-ray diffraction. He stated that Fe_3O_4 would constitute about 15 per cent and would come in the middle of the layering process. Next to the steel would be the FeO itself.

On redirect examination, he stated that he was an expert in identifying substances by x-ray diffraction. He did not claim to be a specialist in paint or mill scale. He reasserted that he found no evidence that FeO will completely disappear.

The next witness was Merion Longenbach of Allentown, Pennsylvania. Mr. Longenbach was employed as a metallographer for BETHLEHEM. He attended Lehigh University and thereafter was employed in the Chemistry Laboratory of BETHLEHEM in 1942. After service in the Coast Guard, he returned to BETHLEHEM in 1946 and joined the Research Department in 1959. He has taken many courses in x-ray diffraction analysis. He has worked in x-ray diffraction at the Homer Laboratories and utilizes diffraction units every day at the Laboratory, including Saturdays on occasion. He has published and co-authored papers on this subject.

Mr. Longenbach performed analyses on samples which had been used by Professor Mairs. He used a log 100 scale for all of his tracings. Professor Mairs used a log 50 scale on some and log 100 scales on others. Mr. Longenbach developed higher peak intensity in his tracings than did Professor Mairs. He found a quantity of alpha FeOOH and some Fe_3O_4. In going into certain detailed samples he stated that Professor Mairs failed to label several peaks and in the witness's judgment marked some erroneously.

On cross-examination, he stated that the point of his experiment was to show that Fe_3O_4 could be formed by the corrosion process alone and still come out with a tall, slender peak rather than a low, blunt peak. He stated that any com-

ponent parts of mill scale, including Fe_3O_4, would produce high peaks. He stated that FeO was the most predominant component of mill scale. If one does not find FeO on a paint chip sample the witness would not be able to determine whether there could have been mill scale on the steel or not. Mr. Longenbach could not tell whether a substance was mill scale or not simply by looking at it.

He stated that he could identify mill scale from x-ray diffraction tests. If a component such as FeO were absent, Mr. Longenbach could not identify the substance as mill scale. He would then have to refer the parties to some other area of expertise to say whether there had ever been mill scale on the surface to which a paint chip had previously been attached. He stated that mill scale does have a layered effect.

The next witness was John O'Brien of Winchester, Massachusetts, who was employed by Arthur D. Little Company. Dr. O'Brien had received a Bachelor of Science degree from Notre Dame and a PH.D. from Harvard University in Metallurgy.

He stated that he heard Dr. M[illegible]ggli's testimony and had conducted a hardness test with a type of gauge which utilized a diamond cutter which makes an indentation under graduated weights. He applied this test to several of the Newport samples. He stated that he doubted that one could test hardness merely by using a needle probing device. His tests were inconclusive because of the breaking of the samples.

The next witness was Mr. Sidney Zecher who had been recalled for further cross-examination.

After discussing his diary and records which consisted of approximately 50 volumes, Mr. Zecher stated that Mr. Hanley, the Chief Paint Inspector, was a good competent inspector and Mr. Zecher agreed to his replacement only because Mr. Hanley was not able to cope with the situation of impending litigation.

The next witness was Mr. Richard Lindstrom of Reading, Massachusetts, who was employed by Arthur D. Little Company since 1956. He testified that he was a senior staff member of the Product Development section of that firm. He received a Bachelor of Science degree in Chemical Engineering from M. I. T. in 1953. His work involves new product development and trouble shooting, particularly in the areas of plastics and resins.

After college, Mr. Lindstrom worked for eighteen months in respect to problems concerning adhesion to steel. He then went into the Air Force for two years, after which he was employed by Arthur D. Little Company. In February of 1970 he was assigned to the Newport Bridge problem. He first inspected the bridge on February 28, 1970. He had not previously done work for BETHLEHEM. He was not sure concerning whether the Arthur D. Little Company had previous contact with BETHLEHEM.

On his first visit Mr. Lindstrom was accompanied by William Johnson, Thomas Elder and other representatives of BETHLEHEM. He was also accompanied by a Mr. Newton of the Electrochemical Division of Arthur D. Little Company. On this visit Mr. Lindstrom observed "measles" or rust spots showing through the paint on the west abutment area. He noted incipient breakdown of paint on the edges of structural members as well as rust coming through on the web of structural members of the suspended span. In February of 1970 he saw incipient breakdown, not by any means a severe failure.

In a subsequent visit in 1971 he noted that the breakdown had progressed quite rapidly to real distress and peeling, particularly in the suspended span area. He looked into the specifications and sought to find test data. There were no such data, but Mr. Lindstrom investigated the past applications of epoxy paint systems on off-shore drilling sites and other marine-type structures.

He made contact with resin suppliers, paint manufacturers and others in order to determine the state of the art. He found that there was little information on red lead polyamide epoxies other than a few papers and some promotional material. He found no prior uses on marine structures of this paint system or a comparable system after having made an intensive though not an exhaustive investigation. He did find evidence of prior use of epoxies as part of a zinc-rich primer. There were also uses of epoxy top coats over a zinc-rich primer.

He checked a study by the National Association of Corrosion Engineers that included hundreds of structures. There were 700 off-shore structures included in this study. Four of the companies used zinc-rich primers on such structures.

Mr. Lindstrom stated that the primer is the important element in corrosion protection. In all of the cases included in the study a zinc-rich primer was used. In no case was a polyamide epoxy used as a primer.

Mr. Lindstrom and members of his firm contacted a number of epoxy suppliers. They were able to locate no literature with respect to an epoxy system of the Newport type. He did not find any data concerning the existence of an epoxy system such as the Newport system. There were data concerning polyamide epoxies used as top coats. There was no use of a polyamide epoxy with red lead as a rust inhibitor as a primer coat such as was used in the Newport project.

Published data indicated that where rust inhibitor pigment had been used with an epoxy, the inhibitor was in the neighborhood of 35 per cent of the total. In the Newport system the volume of pigment was only about 16 per cent of the total. He stated that the paint film has a thermal expansion coefficient four times as high as steel with this pigment volume. The difference in expansion coefficient can cause stresses at the bond of the paint to the steel. The Newport system was

unique in this respect. The pigments were very low in permeability as compared to the resins. The degree of permeability will affect the ability of moisture to permeate the paint to the substrate. The pigment volume concentration (P.V.C.) determines whether paint may be applied adequately to cover at edges and elsewhere and whether it will sag and have other characteristics. He stated that the preparation of a paint system is a very complex task.

He referred to a California Highway Department study (Defendants' Exhibit No. 84) which set forth paint systems which had generally been used on bridge structures and marine structures. This study did not include the application of an epoxy polyamide system, but did deal with an epoxy polyamine system. This system has a different method of curing.

Mr. Lindstrom made a more thorough inspection of the Newport Bridge on April 30, 1970, along with other individuals, some of whom were representatives of BETHLEHEM. He noted that the underfilm corrosion was progressing. He inspected the bridge thoroughly and took photographs.

By April of 1971, the deterioration had progressed to the point of catastrophic failure.

Mr. Lindstrom was informed of the use of this same paint system on the Cape Fear Bridge in North Carolina. This was a short lift span bridge upon which several coating systems were used, including the Newport system on a portion. He stated that the epoxy system used on the lift span was showing essentially the same type of distress as Lindstrom observed at Newport, primarily on the edges. The break in paint film was accompanied by a corrosion which constituted a pattern of reddish rust, followed by black corrosion, bright metal and adhered paint.

He noted that the paint film at Newport after weathering for a few years is extremely brittle. This could be caused by a number of variable factors. This particular paint had its ad-

hesion greatly reduced by the effect upon epoxy of water. Mr. Lindstrom would never, for example, recommend use of epoxy as an adhesive under water. He stated that Dr. Muggli's photographs show the characteristics of the Newport system and its tendency to thin down at the edges. This characteristic would subject the coating to corrosion. Thin edges cause several problems which may lead to a breakdown. These include stress which can cause cracks, increased permeability, combinations of stress and permeability which lead to corrosion. The sharper the edge, the more it tends to thin.

He stated that the Cape Fear Bridge was about 25 miles upstream from the ocean and about 10 miles inland; so that it would not be as severe a marine environment as that of Newport.

He stated that Arthur D. Little Company ran certain tests which coincided with the Spindel physical characteristics tests. He stated that this paint has a tendency to sag when applied to a vertical surface. This tendency was reduced if one stayed with the specified 2 mil coat thickness. Excessive sag will cause poor coverage on the edges because of surface tension which causes paint to pull away from the edges. Sag also makes it difficult to cover bolts and rough surfaces.

Mr. Lindstrom conducted exposure tests in the Arthur D. Little laboratories. He applied this paint to a near-white blast-cleaned steel surface in accordance with the Newport specifications. He exposed the Newport system painted surface on the roof of the building. He also utilized an Intergard zinc-rich primer with an epoxy intermediate primer and an epoxy top coat. He also used a zinc vinyl system (apparently a Mobil product). As to all specimens the edges were striped. These samples were wide flange beams. All were left in this exposed position for approximately three years from September 1970 to January 1974. These specimens were introduced into evidence as Defendants' Exhibits No. 87 through 89.

Prior to putting the beams into exposure, they were scored on the surface. They were exposed on the roof of the Arthur D. Little laboratory which was located about 10 miles from the ocean. There was no heavy industry in the vicinity; it was primarily a residential area.

The Newport specimen, Mr. Lindstrom stated, was the most distressed by the weathering process, particularly on the upper surface and that portion exposed to the sun. The paint was loose and part had come off the surface.

Two plates were also painted with the Newport system coating. Another plate was painted with a vinyl system. These were prepared and scored as were the wide flange beams mentioned above. They were then similarly exposed to the weather. These exposure tests disclosed that the Newport coated plates showed loose paint in the scored area. The vinyl plates showed no undercutting from the scored area. He mentioned that the environment of exposure was much less corrosive than the environment of the Newport Bridge.

Mr. Lindstrom testified that on subsequent inspections of the Newport Bridge, he noted accelerated deterioration, particularly on the suspended span. During these inspections, connection areas were being sand blasted by BETHLEHEM. A zinc-rich primer was applied and an intermediate and top coat of the Newport epoxy system was applied. As the blasting proceeded, previously applied shop-coated paint which had been undercut by corrosion peeled back when adjacent areas were brush blasted. Mr. Lindstrom also noted problems with intercoat adhesion, even where the adjacent paint seemed to be sound. He perceived cracks in the paint which went all the way to the substrate.

In still later visits Mr. Lindstrom observed the remedial work being done by the Cannon employees. They were blast cleaning and applying primer and other coatings at this time. He noted the blasting was at least an SSPC No. 6 standard.

The paint on the formerly painted areas was peeling off. Mr. Lindstrom took certain core specimens for observation and experimental purposes. In each case the examination showed bright clean steel surface with no evidence of contaminants.

On August 23 and 24, 1971, Mr. Lindstrom examined the Cannon work and the BETHLEHEM shop-painted areas. He noted that rust was appearing in the Cannon work, although it was only four months old. This, he stated, was occurring around the heads and threads of the bolts on the gusset plates in portions of the suspended span area. Workmen were touching up these bolts with brushes and green top coating.

On October 20 and 22, 1971, Mr. Lindstrom again visited Newport. He examined the Cannon and the BETHLEHEM painted areas. He did a crosshatch adhesion test at panel point 1' to 10'. This indicated that a fourth coat had been applied. He noted that BETHLEHEM shop-painted portions had become disaster areas. However, the gusset plates looked quite good as late as April of 1972. On his visits after April 1972, the BETHLEHEM-painted areas continued to deteriorate at an accelerated pace. Mr. Lindstrom also noted the development of rust in the recent Cannon-applied paint, which was then about one year old. He visited the bridge during the 1973 painting season. The BETHLEHEM paint continued to deteriorate on the suspended span, but the gusset plates were holding up very well.

In September 1973 he inspected the Cape Fear Bridge. This paint was deteriorating but was roughly comparable to the paint on the west abutment at Newport. It was not as bad as the suspended span.

Mr. Lindstrom also inspected the Gammino approach bridge beginning in 1970, and at subsequent times up to 1973. By 1973 the Gammino portion showed that paint was deteriorating. Speckles or measels of rust showed through on

the girders. The Gammino Bridge is in a protected area, and is protected by being below the highway level.

Mr. Lindstrom inspected the interior and exterior of the bridge towers. The interior paint looked good. In fact it looked much better than the west abutment or the Gammino Bridge. On the exterior of the towers, the general condition was good. In 1973 the hand rails were in relatively good condition. Some evidence of corrosion was observed. These rails had been repainted. On November 8, 1973, Mr. Lindstrom took samples of the Cannon work. At this time there was a large group present including William Johnson, a photographer, the lawyers for BETHLEHEM and also attorneys for the AUTHORITY and its engineers. Mr. Lindstrom took 12 specimens from the suspended span. The area was photographed. The AUTHORITY and the engineers were allowed to take specimens from the same areas. These photographs were introduced into evidence as Defendants' Exhibits 93 (1) through (33).

After scraping certain sample areas of the Cannon repainted work, rust was found under apparently sound paint or on paint where there was only a small spot of rust. The second sample area disclosed black iron oxide under the area from which paint was scraped. Mr. Lindstrom was limited to taking samples in 12 areas and was also limited as to the size of the specimens to four square inches. Otherwise, he stated, he was of the opinion that he would have found more evidence of corrosion. He made microscopic examinations of the paint chip specimens taken on November 8, 1973. He observed on one specimen a thick layer of blue-black layered material similar to what Dr. Muggli had found. Mr. Lindstrom probed the material and found it to be hard. It exactly fitted the Muggli description. The photo of this paint chip under a microscope was admitted as Defendants' Exhibit No. 94. The chip photo also showed bubbles in the primer coat of the Cannon

paint. Mr. Lindstrom furnished to Dr. Peters scrapings from a wide flange I beam section where mill scale had not been cleaned.

Mr. Lindstrom stated that in his opinion the causes of failure of the paint on the Newport Bridge were gross deficiencies in the paint system. These deficiencies consisted of the following elements: (1) Lack of resistance to underfilm corrosion when a break in the paint system occurred. (2) Brittleness of the paint film. This would lead to cracks at the edge of the steel members which would admit salt air and moisture to start the corrosion process. (3) A tendency to form bubbles. (4) The flow characteristics of the paint and its wetting characteristics which provided points of access to the environment. All of these weaknesses are generally attacked by paint companies when preparing new formulations over a long period of testing which this paint did not have.

He stated that to specify this system for a massive structure such as the Newport Bridge would be to proceed counter to scientific techniques normally utilized in the specification of a new paint system.

Then Mr. Lindstrom introduced and commented upon certain meteorological data contained in Defendants' Exhibit No. 95 which demonstrated the rigorous nature of the Newport environment, including snow, temperature and wind direction, as well as fog. He stated that this was a far more severe climate than that encountered in Wilmington, North Carolina, the location of the Cape Fear Bridge.

On cross-examination, Mr. Lindstrom conceded that he was not a paint or corrosion specialist, although he did work on the formulation of an epoxy paint for Arthur D. Little Company during the year 1958. He further stated in cross-examination by Mr. Dolan that the Gammino Bridge from a cursory examination looked better than the Cape Fear

Bridge and better than the west abutment. He stated in this cross-examination that he had given an opinion in April 1970, or possibly before, that the paint system was preliminarily thought by him to be inadequate. At the time of this report, Mr. Lindstrom had seen the Newport Bridge only once on February 28, 1970 and had examined literature in the field.

At this point the cross-examination of Mr. Lindstrom was interrupted to present as the next witness Mr. Walter S. Douglas of Plainfield, New Jersey, who was senior partner of PARSONS. He stated that he had no involvement in the Newport Bridge case until he received a letter from Mr. Lewis April 9, 1970. In answer to this letter Mr. Douglas prepared a letter to the AUTHORITY on May 26, 1970. Between the receipt of the Lewis letter and the preparing of the letter of reply, Mr. Douglas met with representatives of BETHLEHEM and was convinced by these meetings that BETHLEHEM would not proceed with remedial painting.

During this general period Mr. Douglas procured a compilation of logs and other materials relating to the job. He reviewed correspondence with various companies concerning the paint formulation. He also made inspections of the Newport Bridge and observed that certain portions were in good condition as to paint coating, although other areas were in distress.

Prior to May 26, 1970, he believed it probable that Mr. Mandel and Mr. Kinney had raised the question of mill scale, but not as an exclusive cause of paint failure. By May 26, 1970, Mr. Douglas's main preoccupation was to consider the adequacy of the paint system if it were properly applied. He was not attempting to find causes for failure. At that time Mr. Douglas would not have categorized the failure as catastrophic. It was not until later that the full extent of the failure was realized.

Thereafter the cross-examination of Mr. Richard Lindstrom by Mr. Dolan continued. Mr. Lindstrom stated in this cross-examination that in a paint formula qualities must be balanced. Pigment volume content is one of these qualities. Pigment volume content may be increased by adding silicates, but it would be necessary to test the formulation. He could not say what modifications would be appropriate to increase pigment volume content without extensive testing of the alternatives. During this cross-examination several articles and technical bulletins were introduced by PARSONS as Exhibits No. 29 through 31.

In cross-examination by Mr. Hogan, Mr. Lindstrom said there were several paint specialists at the Arthur D. Little Company with whom he conferred in regard to the Newport Project. He stated that he is not a member of the National Society of Corrosion Engineers, but stated that he was accompanied to Newport on his first occasion by Mr. Arnold Eickhoff, who was possessed of more direct experience in the fields of paint and corrosion than Mr. Lindstrom. He stated that he had previously examined certain water pipe in Canada which had been coated with an epoxy system to determine the cause of failure. This was the only time that he was so engaged prior to the Newport experience. He stated that his conclusions in the preliminary report of April 1970 were not labeled as tentative. At that time Mr. Lindstrom had not had physical test data or chemical analysis. He made these conclusions on the basis of a search of the literature which was carried out by a literature search team at Mr. Lindstrom's request. He read what the team gave to him and discussed it with the members of the team. He also checked their bibliography. He stated that the failure on the Cape Fear Bridge was not as extensive as that which was encountered at Newport, but was of the same nature. He last saw the Cape Fear Bridge in September of 1973. Failure had progressed in the same fashion as at Newport.

He stated that in February 1970 he was not of the opinion that the Newport Bridge needed repainting. Later, the paint coating deteriorated rapidly at Newport. The Cape Fear Bridge coating did not deteriorate so rapidly. He stated that he took paint chip samples from the Cape Fear Bridge and examined them under a microscope. He did not run diffraction tests on these samples.

He stated that the area repainted by Cannon employees was showing the same beginning signs of failure which Mr. Lindstrom observed in the original BETHLEHEM paint in February 1970. Without touch-up operations, the Cannon area would become as bad as the BETHLEHEM areas within three to five years. Mr. Lindstrom is of the opinion that the Cannon area had been constantly touched up. He stated that there appeared to have been some touch-up between his 1971 and his 1972 visits. He stated that he could not determine how long it would take for the west abutment area to become as badly distressed as the suspended span area was in 1971, '72 and '73. He questions whether this paint system could be repaired or recoated. This is one of its deficiencies.

He said that there was some, though very little, good BETHLEHEM paint still left on the suspended span as late as 1973. He said the wind velocity, humidity and weather conditions are more severe at the suspended span portion than at the west abutment portion of the bridge. He stated that Mr. Eickoff had made no tests in respect to the Newport paint coating, and that he did not render any report in respect to this job. Mr. Lindstrom stated that he did not run tests to determine the coefficient of thermal expansion of this particular paint system, because he didn't think it to be necessary.

The next witness was David M. Gans of Beachwood, Ohio. Dr. Gans is employed as a consultant. He has received a

Bachelor of Science degree in Chemistry and a Master of Science degree in Mathematics at the University of Chicago. In 1929 he also received a Doctor of Philosophy degree in Physical Chemistry. From 1929 to 1935 he taught physical chemistry, surface chemistry, thermodynamics, spectroscopy, all at the graduate level. Dr. Gans then went with Inmont Corporation, affiliated with Interchemical Corporation, and started as a group leader. He became Assistant Director of Research. He worked on camouflage paint during World War II and thereafter went to work with Quaker Chemical Products Company as Technical Director from 1945 to 1948.

He then went to work for Arco Chemical Company, which is the largest independent paint manufacturer in the country. There he was Technical Director in charge of Research. He then was employed by Coatings Research, Inc. which is made up of 33 medium-sized paint manufacturers. In the aggregate they are second in size only to Sherwin-Williams. Dr. Gans was in charge of research with this firm until his retirement in 1972. He is a member of Phi Beta Kappa and Sigma Psi, honorary scholastic societies. He taught the subject of Organic Coatings at Kent State University. He is also a recipient of the George B. Heckel Award, that is, the major George B. Heckel Award. He is a member of the American Chemical Society and many other learned societies. His list of publications was introduced as Defendants' Exhibit No. 98. These publications include articles and chapters on coatings and surface chemistry.

Dr. Gans stated that paint coating systems consist of three parts: (1) the binder, (2) the pigment, and (3) the solvent. Of these the binder is the major component which gives the paint its integrity. The pigment may be white or of a different color, or it may be transparent in the case of certain extenders. The solvent dissolves the binder and suspends the pig-

ment and then disappears when its work is done. Corrosion is inhibited frequently by the pigment which may have anticorrosive characteristics. Also an additive may be put in which has anticorrosive properties. Some additives may control the flow of the paint. The paint binder makes the greatest contribution to the paint film which consists of binder and pigment. In order to paint, one must apply the paint to the surface and fix it there. This may be done by the solvent evaporating, or in some instances by baking the coat. In order to remain on the surface the paint must dry and cure.

Epoxies may or may not, depending upon their molecular weight, form coatings in and of themselves. Linseed oil is a natural binder and may be used in combination with a dryer. Epoxies are synthetic binders which were developed during the 1930's and 1940's. They are far more durable than linseed oil and have a low permeability characteristic. That is, they are more difficult to permeate than would be a natural binder such as linseed oil. He stated that epoxies result from a long chain of carbon atoms. This may be combined with a fatty acid to make an epoxy ester. This may combine with polyamides (hydroxides) to make an immobile mass or body which is very durable. The Newport system was a polyamide epoxy system.

Pigment volume concentration is a very important consideration in paint. The pigment volume concentration is a ratio of pigment to other nonvolatile components. Primers generally have high P. V. C. ratings. The high P. V. C. deters permeability and also gives a rough surface to which other coatings will adhere. The corrosion will take place only in the presence of oxygen, and water or moisture. The thickness of the film is very important in the process of corrosion in terms of lag time and rate of corrosion. The P. V. C. in the Newport

system was 16.5 per cent for the primer and intermediate coat and 19 per cent for the top coat. In this connection Dr. Gans considered 90 primers and found that they should have a P. V. C. of from 35 to 50 per cent. 35 per cent is most common in terms of P. V. C. rating in primers. He stated that the lower the P. V. C., generally the less tendency to flow. He stated that one of the methods used to overcome the thinning of paint coating at edges is to stripe the edges prior to the main application. It is important that paint be thick enough to deter moisture getting through the paint and also to provide anticorosive protection after it is applied.

He stated that iron corrosive products are much bulkier than the steel itself and therefore tend to push up the paint film. As this occurs, new outlets or inlets for moisture are created. The red lead function is to inhibit corrosion on the surface of the steel. The P. V. C. of the top coat is not relevant to rust inhibition.

Dr. Gans inspected the Newport Bridge August 13 and 14, 1973. On August 13, he cruised around the bridge in a boat and observed its structure from the water. On August 14, he observed the bridge from the catwalk. The suspended span where unrepainted showed rampant failure. It was a very depressing sight. In all his experience he never saw such paint failure. He noted two types of paint failure. One was a freckle or measle type failure which generally centered around a pinhole. In certain of these areas mushrooms or excrescences had developed. The second was edge-type failure. The areas adjacent to the edges showed black corrosion which indicated an oxygen-starved type of corrosion.

The west abutment showed a flat area type of failure, different from the failure on the suspended span. This failure seemed to center around pinholes.

Dr. Gans also examined the Cape Fear Bridge September 6, 1973. The lift span showed the same type of failure as ex-

hibited on the Newport Bridge. He specifically observed freckle failure and edge failure. It looked like a later edition of the Newport Bridge. It was different in degree of failure but not in kind. Some portions of the Cape Fear Bridge looked as bad as the suspended span at Newport. The vinyl portion of the system was very good. On the Cape Fear Bridge certain areas had been brushed over with paint which was not an epoxy type.

Dr. Gans examined the Gammino Bridge on August 13, 1973, and also on April 15, 1974. The Gammino Bridge had gotten worse than it was in August 1973. Freckles had gotten worse, and in some instances the paint could be pushed back from the edges.

On the basis of his inspection of the specifications and his examination of the bridge, Dr. Gans concluded that the paint system applied to the Newport Bridge was preordained to fail because of the following characteristics: (1) low P. V. C. (2) thinness at edges. (3) low inhibiting factor against rust.

In his opinion it was irresponsible to try such a new paint system in such an environment without a thorough testing at the site.

In cross-examination by Mr. Dolan, Dr. Gans stated that he had been telephoned concerning this case by William Johnson in the latter portion of July 1973. He stated that he had never seen the actual formula from which this paint was made, but he has seen and studied the specifications. He further stated that he never actually tested this paint at all.

In answer to a question by the Court he stated that a reasonably close study of the specifications plus a ten-minute calculation should have disclosed the pigment volume concentration problem to any paint expert worth his salt. This should have been discovered by anyone who would formulate a new paint. Dr. Gans came to his opinion about the pigment volume concentration being a major culprit in the deficiency of the paint after about a ten-day to two-week study of the

specifications, plus his inspection of the bridge. This process took place from latter July to mid-August of 1973.

In a cross-examination by Mr. Hogan he again reiterated that the quality of the red lead plus the P. V. C. were the major factors in the failure. He stated that application techniques could not eliminate pinholes. It could only minimize them. He stated that he would differ with Messrs. Frame and Frye in their statement in Plaintiff's Exhibit 143 to the effect that the specifications appeared satisfactory. He said that the west abutment should become as bad as the suspended span in two or three years. The Gammino Bridge might never get that bad because of its protected environment.

On redirect examination he stated that the Cape Fear structural edges were much more rounded than the Newport edges. He further stated that the lack of rust-inhibitive qualities of the red lead in this paint system is a much more important factor than the thickness of the paint. He further stated that an epoxy resin by itself is not a rust inhibitor. Although red lead in a linseed binder is a very good rust inhibitor, where red lead is used with a polyamide epoxy, the red lead may become encapsulated in the epoxy vehicle and not reach the substrate of the steel.

The next witness was David Innes of Alabama. He was a graduate of the University of Illinois with a Bachelor of Science degree in Ceramic Engineering. He was 71 years of age at the time of his testimony. He has been employed by W. A. Case & Son, manufacturers of sanitary vitreous china, where he served in supervision of the control kilns and quality control. He was employed in the early 1920's by Sherwin-Williams Paint Company. He was also employed by a number of other glass companies including Owens Illinois Glass Company. He was also employed and did consulting work for International Paper Company as a corrosion engineer. He served with International until his retirement in 1968 at

Mobile, Alabama. He is a member of the American Society of Corrosion Engineers and many other professional societies. Part of his duties as a corrosion engineer was to consider corrosion problems and find solutions. He also considered and dealt with problems of adequacy of paint coatings.

In 1954 he learned that experiments were being conducted with epoxy systems. He contacted suppliers after observing test results. He studied catalyzed epoxy systems as coatings on caustic tanks. He stated that there was a whole range of epoxies varying from low to very high molecular weights. Tests were set up on seven different coatings on caustic tanks. They tried catalyzed epoxies, polyamide epoxies, mastic vinyl, red lead and various other types of coatings. The tests continued for two years. In these tests the low molecular weight epoxies failed within two weeks to a year. The vinyl systems also failed. The high molecular weight epoxy systems lasted well. All other systems failed. Mr. Innes disagreed with Mr. Roth in his testimony concerning the use of a polyamide two-coat epoxy system similar to the Newport system for tanks at International Paper Company. Mr. Innes stated that International never used anything even close to such a system. He further stated that he never became aware of the use in any paper company of any paint system similar to the Newport system.

He testified that he inspected the Newport Bridge August 13, 14 and 16, 1973. He took a boat ride one day and actually was on the bridge for two days. He examined the west abutment, the suspender span, the east span and the east trusses of the bridge. In this inspection he found brittleness and breaks in the paint in the west abutment. On the suspended span, where Cannon employees had done painting, Mr. Innes saw similar failure as he had observed on the west abutment. In the area of the suspended span where repainting had not been done conditions were very bad. The paint was peeling,

and he noted almost 100 per cent edge failure. He also inspected the Cape Fear Bridge in North Carolina. He found the lift span to be in a state between the west abutment condition in Newport and the unrepainted suspended span at Newport. He also looked at the Gammino Bridge from the roadway. It was located 600 to 700 feet from the main bridge. He saw edge breaks and brittle curling back of paint at these points.

He was not present at the November 1973 inspection of the bridge. He did return to the west abutment area on Wednesday, April 17, 1974. He was prevented from making an onsite inspection by a bridge official. However, in the five minutes that he was present he saw deterioration had advanced considerably since August of 1973. He also noted deterioration had advanced on the Gammino Bridge. He had re-examined the Gammino Bridge April 15, 1974 and found it to be about the same as he had seen on the west abutment. He noted the same corrosion and undercutting.

Mr. Innes' opinion as to the cause of failure of paint on the Newport Bridge included the following points: (1) Low molecular weight in combination with the polyamide characteristics resulted in a brittle film which cracked in a corrosive environment and permitted corrosive materials to penetrate. (2) The low P. V. C. of the primer containing red lead did not give adequate rust inhibiting action and definitely did not prevent the spreading of underfilm corrosion. (3) The spray characteristics of the paint were poor, resulting in thin edges which were vulnerable to corrosion in a severe corrosive environment. (4) The poor spray characteristics also resulted in pinholes and gunshot rust speckling or measles. This resulted in blistering, bubbles and star checks, which are cracks radiating from a pinhole. This gave rise to weak points in the film where corrosive attacks started. These defects in the coating, particularly the spreading, undercutting and underfilm corrosion, prevented normal touch-up repair methods.

For these reasons, it was Mr. Innes' opinion that the untested Bradley specification for an epoxy polyamide paint did not provide protection to the steel in this severe marine environment.

On cross-examination by Mr. Dolan, Mr. Innes testified that the Cannon Company did painting for International Paper Company on new construction work. He stated that these were epoxy systems which were applied. In this cross-examination he stated that the Gammino Bridge was better than the west abutment and that the BETHLEHEM area of the suspended span was considerably worse than either. He also said that the Cape Fear Bridge was generally better than the west abutment at Newport but in places it was just as bad. He stated that he saw evidence of edge failure and measles on the newly painted Cannon surface area. He also stated that the Cannon blast cleaning was in just about every instance superior to the SSPC No. 6 standard. He further stated that he saw pinholes and some starring in the paint which had been applied in 1973 by Cannon as well as in the 1971 and '72 work. He was not allowed to use a knife on the Cannon paint. He said that the epoxy usd in the Newport system had the lowest molecular weight of the solid epoxies.

On cross-examination by Mr. Hogan, Mr. Innes discussed the surface of the Gammino Bridge and stated that of approximately 3,240 square feet, only about one square foot was denuded of paint. He was unable to say how many feet of edge failure existed at the time of his inspection.

He stated that he first had contact with the Cannon firm in 1956, on a new construction project. He met Mr. Roth at that time. Thereafter, Cannon did a good deal of painting for International Paper Company. He found Cannon to be a good paint contractor provided that good equipment and supervision was furnished.

He stated that in his opinion if one began to repair the Gammino Bridge it would turn out the same as the suspended span. One would find that very little paint could be saved and it would be necessary to blast nearly all of it.

The next witness was Kenneth Bushnell Tator of Coraopolis, Pennsylvania. He was the owner of Kenneth Tator Associates, a firm of paint consultants. He had received a Bachelor of Science degree in Chemical Engineering from Lafayette College in 1963 and a Master of Arts degree in Business Administration from Columbia University. He worked for the Scott Paper Company, entered the naval service from 1963 until 1966, and then went into business with his father, until his father's decease in 1969. The Tator test panel was developed by his father and is the backbone of the business. Mr. Tator's firm has about 15 test panel sites throughout the country. Some of these sites are inland, and some are on the Gulf coast. These test stations are used to test coatings in various types of corrosive environments. The company has done this work since 1947.

The Tator test panel is a 4 × 6 inch flat plate, 3/16 of an inch thick. A channel is welded to it, containing various irregularities such as sharp edges, rounded areas and the like. The exposure period usually is 18 months to two years in duration. They have tested a great variety of systems, probably 50 to 60 thousand different combinations.

Besides the test stations, the company derives income from inspection services and analysis of causes of paint failure. Also it sells paint-testing equipment such as film thickness gauges, thermometers, weather meters and similar equipment. The firm does all the testing for Alcoa, U. S. Steel, a number of paint suppliers and a number of paint users. The witness has served as Chairman of the Zinc-rich Preparations Committee of the Steel Structures Painting Council. He belongs to the National Association of Corrosion Engineers,

the Pittsburgh Society of Paint Technology, and many other professional societies, including the Nuclear Power Plant Painting Committee.

The Tator firm does laboratory testing of paints, such as salt-fog chemical reagent tests, chemical fume chambers and various other accelerated tests. He has had experience with epoxy paints including tests, applications and consultation. Epoxies are widely used in the nuclear field. Those so used are usually phenolic epoxies.

To Mr. Tator's knowledge, Newport was the first application of an epoxy coating on a bridge. He was contacted July 1973 by Mr. Howard Feldman of BETHLEHEM. He visited the bridge July 27, 1973 and wasn't allowed to go upon it. He looked at it from the ground for a couple of hours. He observed many failures from the ground, on the west abutment. These failures were readily apparent from his position. He again visited the bridge August 13, 1973. He started with a boat ride and on August 14, 16 and 17, 1973, he visited the bridge again. It appeared that there was widespread failure throughout the bridge, particularly along the edges. He visited the west abutment and noted that the coating was failing on the edges, and also measles were appearing from pinholes. There was a peeling and curling back of the paint. He made a litmus paper test which disclosed no indication of water soluble chemicals on areas where paint had been removed. He peeled back paint and tested for thickness.

On August 14, 1973, he watched the Canno preparation of the surface by grit blasting. In his opinion the Cannon employees were doing an SSPC No. 10 cleaning job, or near-white standard. This was superior to the SSPC No. 6 commercial blast. Mr. Tator removed some Cannon paint but was told he could not continue to do this. He removed a lot of samples of the BETHLEHEM paint and in many cases he picked it off with his fingers.

Where the paint was peeling he noted a brownish-black contaminant, but as one went into this, one would find a bright clean metal about half an inch from the pinhole, and maybe eight inches from a failed edge. The coating appeared generally to be well applied. The thicknesses were about as good as other shop-applied paint jobs which Mr. Tator had seen. He took about 75 to 100 dry film measurements on the west abutment and from the catwalk on the suspended span as well as from the gusset plates. The vast majority of tests showed a thickness of 6 mils or better. In some areas there were less than 6 mils. The gusset plates had 17 to 18 mils. On August 17, he again examined the paint and took a number of slide photographs which demonstrated the various stages of corrosion and undercutting. He said that the state of failure in the suspended span area was much worse than at the west abutment. He further stated that in testing paints at Curie Beach, North Carolina, he had set out some specimens 80 feet from the sea and others 800 feet from the sea. He noted that the specimens at 80 feet locations showed much more serious failure, all other factors being equal, than those which were 800 feet from the sea.

He stated that on September 6, 1973, he and a group of others visited the Cape Fear Bridge, which had been painted with a three-coat epoxy system on the lift span area. He found the edge failure and spot rusting to be similar to that noted on the Newport Bridge. The failure was not quite as prevalent as at Newport, but it showed tendencies in that direction. He demonstrated his inspection by the use of slides.

He stated that there is a substantial difference in the severity of corrosion as one approaches sea water. The difference may be measured quantitatively, although he was not prepared to put a figure on such quantitative differences. However, he was of the opinion that the difference in the rate

of corrosion at the west abutment and the Gammino Bridge was due to their distance from the salt water.

He stated that he was present at the Newport Bridge in November of 1973 when samples were taken of the falling paint. On this occasion he picked paint off with a needle. In some instances the paint which gave no sign of failure was removed and no corrosion was found on the steel. In other instances there were signs of failure on the surface, and on removal of the paint the failure underneath the coating was much more extensive than the surface failure would indicate. He commented in detail on several of the samples.

He stated that in all of his inspections of the BETHLEHEM area, he did not find any mill scale or failure due to mill scale. In his past experience he had found that mill scale failure gave rise to a peculiar "popoff" type of failure. Mill scale, he said, will usually fall off in chunks. Adjacent areas will generally remain intact. Where mill scale occurs, there will be a black or brownish product on the underside of the paint chip. Where the paint is firmly on a clean substrate, there should be no undercut or spread of corrosion. He said that he felt it to be physically impossible for mill scale to be on the edges of structural members, because they get the greatest impact from the abrasives used in a blast cleaner. It would be much more likely to find mill scale on the sheltered areas of the flange-type members.

On the whole, it was Mr. Tator's opinion that the cause of failure at Newport was not from mill scale or surface contaminants. He stated that the cause of failure was a lack of rust inhibiting qualities to prevent underfilm corrosion, and also the following factors: (1) The low P. V. C. (2) The brittle paint which tended to crack. (3) The aggressive marine environment which caused more rapid failure than would have occurred elsewhere. He stated that the edges could not be covered with sufficient coating of paint to protect the sur-

face. This particular paint would have excessive surface tension which would cause even an ample wet volume to be diminished at the edges.

On cross-examination by Mr. Dolan, Mr. Tator stated that he has not exposed any of the Newport paint system to his Tator test panel or to his outside testing stations. He stated that when he examined the suspended span, only about 10 per cent remained to be repainted by Cannon. He further stated that it was his understanding that the paint has been on the Gammino and Cape Fear Bridges for some six to seven years.

He stated that one would not note the edge problem while applying this paint in the Pottstown factory. Even a skilled painter would probably think he was getting good coverage on the edges. He stated that merely reading the specifications would not suggest any problem with pigment volume concentration or flow or any of the other problems. On cross-examination by Mr. Hogan, he stated that the Gammino Bridge and the Cape Fear Bridge are about equally good in condition. Next would come the west abutment and then the towers, in terms of conditions. The worst would be the suspended spans and the truss spans. He said that the Cannon job is already showing incipient rusting and failure, but one cannot tell when it will become as bad as the BETHLEHEM areas.

The next witness was William C. Johnson of Kintnersville, Pennsylvania, who was employed by the BETHLEHEM Steel Company at the Homer Research Laboratories as a research engineer. He received a Bachelor of Science degree in Chemical Engineering in 1941 from the University of North Dakota. From 1941 to 1957 he served as a technologist in the Marshall Laboratory, which is a subsidiary of the DuPont Company. His work there consisted of research in paints. Much of the work was done on house paints, metal primers,

chemical-resistant coatings and the like. He then transferred to the Sales Development Laboratory where he was engaged in the development of new products. Among other projects, Mr. Johnson worked on the Manhattan Project relating to the atomic bomb. He went to work with the Homer Research Laboratories in 1957.

He is a member of the American Chemical Society, is an associate in paint technology. He is a member of the American Society of Corrosion Engineers and is co-author of two publications on the intercoating of tubular containers and moisture-resistant coatings for metal products. He holds a patent on coating for rusty steel. He has had very little contact with epoxy coating systems from 1957 to 1970. Most of his work related to the corrosion of various types of steel and agents to inhibit such corrosion.

In December of 1969 Mr. Johnson was requested to work on the problem of paint at Newport. He was asked to do this by the Fabricated Steel Construction Division of BETHLEHEM. He visited the bridge site for the first time in February of 1970. Before visiting the bridge he read the Section 7 specifications and studied commercial literature on epoxy coatings. He made a number of visits to the Newport Bridge, the Gammino Bridge and the Cape Fear Bridge from February 1970 up to April 20 of 1974. He also made a number of tests in the laboratory which were compiled in a folder introduced as Defendants' Exhibit No. 109. These tests included composition tests, edge studies, wind corrosion, permeability, pigment volume, and tests of other paint systems. The tests were conducted from June of 1970 to August of 1972. They were conducted under Mr. Johnson's supervision at the Homer Laboratories.

In respect to pigment volume concentration, Mr. Johnson did some work on the Newport system. He defined pigment volume concentration as the percentage by weight of pig-

ment solids after elimination of the volatile components. He stated that pigment volume was not set forth in the specifications. It is not customary to express this element in the specifications. Usually the constituent parts are specified by weight. You must then make a calculation to discover the percentage. In the Bradley specifications there is one component made up of epoxy resin solids and a second component made up of red lead, polyamide resin solids and solvents. It is necessary to know the density of these ingredients. Therefore, you could not get an indication of pigment volume concentration by just reading these specifications. The Bradley 1962 specification indicated a pigment volume concentration of 30 per cent, but the Section 7 specification produced a pigment volume concentration of 16 per cent.

In an examination of the trade literature, including the Ciba report identified by Dr. Gans, it appeared that the percentage of 35 per cent of pigment volume concentration was most frequently encountered. In his development studies, Mr. Johnson sometimes computed P. V. C. At the DuPont Company most of his work involved development studies. On one occasion a study involved pigment volume of house paints.

In respect to his numerous visits at the Newport Bridge between 1970 and 1973, Mr. Johnson noted that deterioration progresses like a snowball running downhill. When he first saw the bridge in 1970, he would never have believed that it would deteriorate to such an extent by 1973. Never in his experience has he seen such failure.

There were then introduced a number of slides showing portions of the Cape Fear Bridge, the Gammino Bridge and other portions of the Newport Bridge.

Mr. Johnson testified that he set a wetness meter on the Newport Bridge. He tried to measure different environmental conditions on the suspended span and the west abutment.

Consequently, he put out one set at the west abutment and one set on the suspended span. He measured how much of the time a piece of cloth was wet. These tests disclosed that the west abutment area was wet about 19 hours per month, while the period of wetness was about 82 hours average per month on the suspended span or four to six times as much. In the upper portion above deck he found wetness 121 hours per month. He stated that on several occasions he observed the suspended span shrouded in fog when it was clear at the west abutment.

He inspected the Cape Fear lift span with particular attention to edges and found that edges of structural members at Cape Fear had been rounded to a greater extent than at Newport.

He also measured the dry film thickness at Newport. All such measurements were made in the company of Mr. Buschbom. He used a magnetic sensor, although Section 7 specifications call for an Elecometer, which is another type of magnetic gauge. He took measurements on the flat surfaces only because he couldn't take measurements at the edges. He took measurements of both the Cannon and the BETHLEHEM paint. Both dry film thicknesses on the average were higher than 6 mils. He also performed dry film thickness test on the mounted Muggli paint chips (Plaintiff's Exhibit No. 83). He did this with a microscope and found that at the edges they were less than 6 mils in thickness, but at other places they were more than 6 mils in thickness. He did a dry film thickness test on specimens introduced by Mr. Buschbom. Sometimes he utilized a microscope. In all instances other than the microscopic examination he found them to be more than 6 mils in thickness. In the microscopic examinations four showed thicknesses of 5 mils.

He performed a number of tests relating to the rheological characteristics of the Bradley system (flow, surface tension,

etc.). He stated that the pigment volume affects the thixotropy. The viscosity of a thixotropic system is low, but it will not flow under zero force. The pigment particles act like a straw pile. The higher the pigment volume, the more tendency for the paint to stay in place. In tests which he performed on Bruder paint, some of which was as specified by Bradley, and the other type was paint to which more pigment had been added to achieve about 35 per cent P. V. C., he found that the high P. V. C. reduced sagging markedly. The high pigment paint was more thixotropic where the lower pigment paint was more newtonian. He stated that the brittleness of paint affects the ability to withstand the upward force of corrosion product. This lifts the brittle paint away from the surface of the steel. The film cracks at the edges due to brittleness and then lifts off due to the pressure from the corrosive product. He stated that the causes of failure of the three-coat epoxy system used at Newport are as follows: The rheological characteristics of this paint result in thin film at the edges, which leads, along with the brittleness characteristic, to cracking at the edges and to underfilm corrosion.

In cross-examination by Mr. Dolan, Mr. Johnson stated that he had very little contact with a two-component epoxy system at BETHLEHEM before the Newport Bridge project. He had some contact with such system at DuPont prior to and including 1957.

In further cross-examination by Mr. Hogan, the witness stated that the characteristic termed "newtonian" indicated its subjection to the law of gravity. He stated that he could not define the term "thixotropic" in words, but attempted to define it by way of an example of whipped cream and catsup. In determining brittleness he relied on his observation of the chips but did not perform laboratory tests.

He stated that the Cape Fear failure was essentially the same as at Newport. He found that in September of 1973 the condition of the Cape Fear Bridge was comparable to the

Newport Bridge, as it was in 1970 and '71. The west abutment, the Gammio Bridge and the Cape Fear Bridge are "all in the same general ball park," though the west abutment is worse than the other two.

He stated that the Cannon work done in 1971 is close to being in the same condition as the BETHLEHEM paint was in 1971. Within a year or so, it should be the same in respect to delamination and its distress will become apparent from a distance. He stated that the Cannon paint applied in 1971 was already a premature failure at the time of his testimony. The same was true of paint applied by Cannon in 1972, but he has not had an opportunity to examine the 1973 Cannon paint from this point of view. He first concluded that the Cannon paint applied in 1971 was a premature failure by November of 1971. There were many signs of trouble at that time.

The next witness was Leo John Manta of Illinois, who was employed as Vice President of J. L. Manta, Inc., a company engaged in the industrial paint contracting business. Mr. Manta stated that he had been so employed since 1954. His firm has done painting work on bridges, power plants, industrial structures and highway structures. The company employed between 200 and 600 painters and auxiliary personnel. It has performed work in various parts of the country east of the Mississippi River. Among other projects, this firm did the paint work on the Cape Fear Bridge. It maintains offices in Chicago, Pittsburgh and Atlanta. Mr. Manta has served as Project Manager at Cape Canaveral, Florida for this company.

He testified that he has been involved in the application of epoxy coatings, but the only job where he applied a red lead epoxy primer was the Cape Fear project. He stated that he became involved with the Cape Fear project in 1967 during the building stage. The American Bridge Division of United States Steel Company was the general contractor. Mr. Manta

stated that the steel for the structure had been blast cleaned at United States Steel facilities but not painted. The Manta employees coated the steel in a shop rented from the Port Authority. The Manta employees began painting about June of 1968. In July of 1968 a meeting was called to consider problems which had arisen concerning the edges. Mr. White of the PARSONS firm stated at the meeting that the edges had to be relieved to a radius of 3/16 of an inch or the paint system would not work. Such an action would eliminate the sharp edge. In accordance with these instructions, all edges were relieved as indicated.

The Manta employees put the painted steel on barges and towed the steel structural members to the site where they were installed by employees of the American Bridge Division. Also, the Manta employees did some painting on the bridge after the structures had been installed. Mr. Manta stated that his workmen had a lot of problems with intercoat adhesion. The first coat adhered to the steel satisfactorily, but subsequent coats tended to delaminate.

The workmen varied their drying time to four hours from the eight hours as set forth in the specifications. As a result, the first coat was not so hard when the second coat was applied, and therefore, the second coat would bind more readily to the primer. They also added an undercoat softener to the intermediate and finish coats.

After the erection of the bridge structure, Manta employees were required to paint the lift span all over again. They brush-blasted the visible rust and repainted the structure. They did the control room over at least three times. They found rust on all of the bolts and edges as well as measled rust spots in various places. Even in ares where the paint appeared to be sound, if one were to cut into it, one would find unbelievable amounts of rust. The lift towers and the lift span had to be completely repainted, and certain portions thereof were required to be repainted several times.

Mr. Manta stated that in certain instances his company's employees purchased ordinary linseed oil based enamel paint from a local hardware store. This was the only paint which was any good, Mr. Manta said. The workmen used perhaps 100 gallons of this type of paint.

On cross-examination, it was learned that the Manta firm lost $300,000 on the Cape Fear job, and that Mr. Hynes, attorney for BETHLEHEM, represents the Manta firm. He also stated that his men were required to blast all steel to a white metal finish. He stated that when the steel came to his men, after having been blasted to a commercial standard by U. S. Steel, some of it was still rusted and some still had mill scale on the surface.

Mr. Manta stated on redirect examination that the hardware enamel areas on the Cape Fear Bridge were in fairly good condition in 1972 and had not chalked to the extent of that noted in the epoxy areas. He stated that the epoxy coating had a fantastic tendency to stay away from edges. It would not cover the edges at all. In fact, he stated that it would be necessary to put 18 to 20 mils of paint on adjacent areas in order to achieve 6 mils on the edges. Putting 18 to 20 mil thickness on flat surfaces would cause a tendency for the paint to fall off.

The next witness was Valentino J. Assetto, who testified that he had reviewed the calculations of Mr. Roth, and found certain mathematical errors. Among other errors, certain areas of coverage were duplicated. He introduced his recalculation as Defendants' Exhibit No. 139. He stated that the paint work still to be done would cost $1,285,319 if the adjusted figures of Mr. Roth were used, but the errors and duplications were eliminated.

Mr. Assetto then proceeded to deal with the delay matters set forth in the Defendants' counterclaim. I shall summarize the evidence concerning the delay claim at another place in

this decision. The Court will pass over the testimony of Thomas J. Elder and other witnesses who dealt with aspects of the delay claim asserted by Bethlehem in order to keep the testimony concerning the paint controversy in one coherent presentation.

The Court will deal with the testimony of Mr. Elder as it related to the paint controversy. Mr. Elder served as the Project Manager for BETHLEHEM at the Newport Bridge beginning in the latter portion of April 1966. He is a graduate of Cornell University and is a licensed professional engineer in the State of Pennsylvania. He as been an employee of BETHLEHEM since 1950. He has served in various capacities and since 1969 has been a project engineer on a large number of bridges, viaducts and highway structures. He testified that field painting was performed in 1967, 1968, 1969 and 1970. The painters worked from the west abutment eastward as far as Pier 22E. The field painters did some work on the towers and coated the field connections which were unpainted at the shop. There was early evidence of distress noted at the edges. Measletype corrosions were also noted, but the failure was not typical of what was later observed, certainly not in quantity. A small amount of remedial painting work was done in 1967, primarily in the areas where measle corrosion was observed. Only about 5 per cent of the structure was painted in 1967.

In 1968, a considerable amount of painting was done on the east and west approaches, and some work was done on the towers. They also painted field joints in that year. Distress was observed in the shop-applied paint, particularly on the main tower plate edges. The paint was peeling back from both surfaces which came together at the edge. Employees also noted splotchy gray areas on girders and truss structures. The failures noted during the year 1968 were not nearly as great as they appeared in later years. Then other break-

downs appeared in areas where normally problems would not be encountered. The areas of failed paint were cleared by hand and the structures repainted with three-coat epoxy. At the end of the 1968 painting season about 35 per cent of all field painting had been completed.

In August of 1968, as a result of a meeting with Mr. Bradley and others at the PARSONS office, it was agreed that a zinc type primer should be used instead of the red lead primer. Thereafter, BETHLEHEM began to use a single component zinc-rich epoxy as a primer. The name of this zinc primer was Intergard. The painters continued to use the primer set forth in the specifications as an intermediate coat.

Additional distress continued to show up throughout the structure in the form of edge failures and measles. After January 1970, BETHLEHEM did some further painting on the suspension stiffening trusses and on the east approach areas. Mr. Elder stated that BETHLEHEM repainted certain areas which were shop painted wherever there had been erection or shipping damage, or wherever paint was breaking down. This remedial work was done by hand for the most part. He stated that the engineers conducted an inspection of the job in January 1970 and a portion of the retainage funds on the job was released. In 1970 BETHLEHEM painted the suspended span area, the two main towers, the unfinished portion of the east approaches and did field painting at the suspended span and on the trusses between Piers 2W and 5W. Also, BETHLEHEM painters did some remedial work in that area.

Also in 1970, the engineers requested further remedial painting work which BETHLEHEM refused to perform. Mr. Elder stated that there was rampant distress in the shop painted areas. The edge failure, loose paint with corrosion below the surface and other corrosive failures could be seen all over the structure. He stated that BETHLEHEM refused to correct these failures.

There was then introduced a summary of costs incurred for all field painting between 1967 and 1970. This summary was marked as Defendants' Exhibit No. 244.

The next witness was presented by PARSONS, out of the ordinary order of proof. It was agreed by counsel that Mr. Dolan might present this witness without waiving his right to make an appropriate motion at the close of BETHLEHEM's case. This witness was Raymond R. Myers, who was serving as Chairman of the Chemistry Department at Kent State University. He also served as Research Director of the Paint Research Institute of the Federation of Societies for Paint Technology. Professor Myers has been Chairman of the Chemistry Department at Kent State since 1965 and has served as Chairman of the Paint Research Institute since 1963. Professor Myers seeks out the best people to perform basic research at the institute. They normally do not engage in solutions of practical problems, but concentrate more on problems of a theoretical nature. There are local agencies of the institute throughout the United States and abroad. Prior to serving at Kent State, Professor Myers was employed at Lehigh University in Pennsylvania as a faculty member, where he ultimately attained the rank of full professor. He had also been employed as a research agent at Monsanto Chemical Company. His academic degrees include a Bachelor of Science from Lehigh University, a Master of Science from the University of Tennessee, and a Ph.D. in Chemistry from the University of Tennessee.

He is a member of the American Chemical Society and President of the Lehigh Valley section of that society. In 1964 he served as Chairman of the Organic Coatings Division of the society. He has served as a lecturer for the American Chemical Society and also for the British Society of Rheology (the science of flow). He has served on the Materials Advisory Board of the National Academy of Sciences, for the purpose

of studying the adhesion of epoxy paints, although he is not a member of that society.

His academic honors include membership in Sigma Psi and Phi Beta Kappa, as well as a fellowship in the Institute of Chemists and membership in the National Research Federation of Canada. He has received a number of national awards, including an award from the New York Academy of Sciences, an award in plastics research, and has received the coveted George B. Heckel Award in 1973. This last award is among the most outstanding in the field of paint and coatings. He is the author of approximately sixty publications, one of which is an article written for the Encyclopedia Britannica on the subject of paints, varnishes and related products. He has edited a book on rheology, and the research aspects thereof, as well as a treatise on coatings which has just been published. A more complete list of his publications and expertise may be found in PARSONS' Exhibit Nos. 40 and 41. His testimony was taken out of order because of an engagement which he had in Australia for a series of lectures and also a research project involving paintings by aboriginals.

Dr. Myers first examined the Newport Bridge on December 7, 1971, where he was accompanied by Mr. Zecher and a number of other persons. He had been contacted a few weeks previous to this visit. He walked down the center span and took a general view of the extensive paint failure. He observed that roughly half of the paint had failed. No particular pattern of failure could be observed.

There appeared to be a general failure, though it was particularly noticeable on rolled structural members. The only parts which were not generally in distress were the splice plates. Dr. Myers took a number of paint chips which proved on examination to have magnetic oxide on the back side. He then drew a tentative conclusion that this substance must have been mill scale formed at high temperatures rather than rust formed at ambient temperatures.

On December 18, 1971, Dr. Myers visited the bridge again and took representative paint chips at random, but selected from different portions of the bridge. He was assisted in gathering these paint chips by Mr. Buschbom. These samples were gathered in a westerly movement from panel point 74 to panel point 60. At this time, repainting had begun to the easterly.

Dr. Myers took five core samples and ten packages of chips. A package of chips was a group which had been obtained from the same general area. He looked at the truss area, both east and west. He then looked at the west abutment and the Gammino Bridge areas. He noted that the Gammino Bridge had an excellent protective coating and gave no significant signs fo failure.

He gave the paint chips to Roger Loofbourow of Crobaugh Laboratories for diffraction tests and also submitted the core samples to that agency for examination. In February of 1972, Dr. Myers received a report on core sample No. 3. He caused chip No. 6 to be mounted in plastic with a U-shaped base. A microscope was set up at 500 magnification. Cross sections were prepared of the chip and the core. Magnified photographs were introduced of the cross sections of the paint covering on the steel core as well as a cross section of paint chip No. 6. These were marked PARSONS' Exhibit No. 42 and 43 respectively. Dr. Myers noted a predominant species of black layer under the paint which he stated to be Fe_3O_4 or magnetic oxide. From this examination he formed the belief that the substance was mill scale.

On April 12, 1972, he revisited the bridge, and had more samples taken by Mr. Buschbom and others. At that time he noted that repainting was in progress and felt that the newly painted areas were holding up well.

Crobaugh Laboratories were asked to examine all chips from No. 6 through No. 19. Eleven out of these thriteen chips

showed that Fe_3O_4 was present in sufficient quantity. One chip (Chip No. 11 had an insufficient sample upon which to form a conclusion.

He noted that in almost every case, examination of the chips showed the paint faithfully followed the contour of the oxide and penetrated it where crevices appear. This observation suggests that the oxide was there when the paint was applied.

Dr. Myers expressed the opinion that the black material on the back of the paint chips was mill scale. He was not disturbed in this conclusion by the absence of a finding of the compound FeO. He stated that this was not surprising, since the paint chips had weathered over a period of time, and FeO would not last long under such conditions. It was his opinion that the mill scale was the cause of the paint failure at the Newport Bridge. This failure was due to the fact that mill scale has a different coefficient of expansion than steel and would therefore cause the paint to cover to crack and rupture. He also stated that the mill scale would become a cathode, reacting to the anode of iron, and thus would cause a creeping rust.

Dr. Myers' observation of the remedial painting job was that it appeared to be as near perfect as a commercial job could be expected to be.

He also stated that he had examined the Newport Bridge again on May 27, 1974, after his earlier observations of December 7, 1971 and April, 1972. He stated that in his opinion the expected life of the Cannon paint work would be easily ten years.

On cross-examination, Dr. Myers disclosed that he is a chemist rather than a metallurgist, and that he does not specialize in corrosion. He further stated that although his first report indicatetd that Fe_3O_4 was formed only at high temperatures, he is now of the opinion, as in his last report, that

Fe_3O_4 may form at lower temperatures. He expressed the opinion that mill scale could be left on a steel surface in an automatic cleaning or blasting device in islands resulting from swirls and eddies which occur within the device. He stated that he might be able to detect mill scale on the surface of steel by use of the naked eye, but he is not a trained expert in the viewing of steel and in determining its cleanliness after blasting. Upon being presented with two photographs of paint samples taken from the Cannon area (Defendants' Exhibit No. 94) and a sample taken from the Gammino Bridge (Defendant's Exhibit No. 94) and a sample taken from the Gammino Bridge (Defendants' Exhibit No. 121), he stated that he could not tell what these contaminants were from mere visual observation but would express the opinion that the contaminant was there when the paint was applied.

Mr. Thomas J. Elder resumed the stand. Much of his remaining testimony related to delays in construction. This testimony will not be summarized here. However upon cross-examination by Mr. Dolar, he noted that neither Conomos nor BETHLEHEM had kept any separate record on repainting of failed areas as opposed to the painting of bare steel and the touching up of abrasions resulting from construction and handling. He stated that in September 1969, there had been a meeting of various interested parties at BETHLEHEM, including Mr. Conomos. No minutes of that meeting were kept. However, a memorandum of the meeting was written by Mr. Elder and introduced as PARSONS' Exhibit No. 53. This memo indicated that lightly coated edges could not take the abuse of handling and nested type storage. Some pieces had been stored for two years before erection.

Thereafter, certain portions of a deposition give by Mr. Alfred Hedefine were read into the record by Mr. Hynes. Mr. Hedefine stated that the selection of the paint system was made by Mr. Mandel and Mr. White. Mr. Hedefine had no

specialized training in paints other than that which was derived from his experience. He was not a paint expert. Mr. Hedefine was aware that this epoxy coating system had not been used on a bridge before, but he also knew that the system had been used in various areas and on various structures, so that it was not a new system. Mr. Mandel was involved in the final selection of the Newport paint system. He made inquiry of Mr. White about November 1965 concerning the system. Piror thereto he was not involved in the preparatory work. He relied primarily on the expertise of Mr. White.

Thereafter, certain portions of a deposition of John J. White taken December 9, 1971, were read into the record by Mr. Hynes. These excerpts generally were corroborative of points which Mr. Hynes had previously brought out on cross-examination of Mr. White.

The next witness was Shelby F. Thames, who was presented on behalf of PARSONS. Dr. Thames resided in Hattiesburg, Mississippi and had served as Dean of the College of Science and Technology of the University of Southern Mississippi. He was a Professor of Polymer Science. He was a Director of the Institute of Surface Coatings. As Dean, he supervises ten academic departments of the university. His education includes a Bachelor of Science degree, a Master of Science degree, and a Doctorate in Philosophy in Organic Chemistry, all received from the University of Tennessee. He was a member of a large number of learned societies including the American Chemical Society, Federated Paint Consultants, and the American Institute of Chemists. He has written thirty publications, all of which are summarized in his curriculum vitae, which was introduced as PARSONS' Exhibit No. 55.

He stated that he has been almost exclusively engaged in the field of polymers and coatings. His university now offers a degree in polymer science ranging from Bachelor of

Science through Doctor of Philosophy. Dr. Thames' specialty is in the field of organic polymer synthesis. He stated that paints are a category of polymers. He stated that he had experience with epoxies, which are a type or class of polymers.

He stated that he visited the PARSONS office May 7, 1972. Among others, Dr. Long, Dr. Myers, Mr. Dolan, Mr. Hedefine and Mr. Zecher were present. Dr. Thames had been invited to attend by Dr. Long. On May 11, 1972, Dr. Thames visited the Newport Bridge and inspected the suspended span. He saw a general failure in the paint system.

Thereafter, he performed crosshatch adhesion tests on various portions of the bridge where the paint was apparently holding up well. In three cases he found one hundred per cent adhesion, in one case eighty-per cent adhesion. He had been advised that the paint had been applied approximately four years prior to his visit.

He also noted that remedial painting work was being carried out by Cannon employees. He observed that Cannon was doing a good job, and that paint which had been applied in 1971 looked good. Dr. Thames took with him a copy of the paint specifications.

Dr. Thames again visited the bridge on June 8, 1972. He was accompanied by Mr. Zecher and obtained cores from panel points 42, 43 and 61. He selected cores from beam girders and rolled members. He wanted to see if these different areas would show a significant difference in surface preparation. He later submitted these cores to Dr. J. R. Hancock of the Midwest Research Organization for tests. Dr. Hancock was a metallurgist.

Dr. Thames obtained samples of the Armstrong paint of the type used on the Newport Bridge from Mr. Zecher. He tested this paint for tensile strength and elongation. He made a three-coat application to photographic paper, then immersed the painted paper into water, where the paper was

separated from the paint. He then divided the paint film for testing. The test disclosed that the paint had good tensile strength and good elongation. In short, he found that the film was tough.

He tested the paint for permeability to water vapor. He tested the paint for its capacity to absorb water and for flexibility. From all of these tests the paint performed well, as to hardness, adhesion, impact resistance and permeability.

He then made comparative tests of several types of coatings which showed the Armstrong paint system to be superior in all respects. He also did some salt fog tests with a zinc phosphate panel and cold rolled steel, as well as iron phosphate aluminum and sand-blasted steel which had been pickled in hydrochloric acid. He applied paint to these panels, using a graduate student to spray the paint under his direction.

After more than 2600 hours in the salt testing box, the panel held up very well. One panel was not cleaned prior to the application of paint. The failure to clean the panel gave rise to more rust than where the cleaning had taken place.

He compared the Armstrong paint system with various other coating systems for durability and vital characteristics. As a result of these comparative tests, Dr. Thames found that the Armstrong product rated very high and performed very well. He stated that the salt box exposure of 2,000 hours was equivalent to approximately ten years of normal weather exposure. He was further of the opinion that the paint system specified by Section 7 of Contract No. 3 was highly suitable for application to the Newport Bridge.

He again visited the Newport Bridge on June 15, 1974, viewed the paint which had been applied by Cannon employees, and concluded that this new paint had a probable life expectancy of twelve to fifteen years from the time of the application.

He visited the Cape Fear Bridge on Thursday, June 13, 1974. The epoxy coating was holding up very well. The total life expectancy of twelve to fifteen years from the date of application was his estimate as to the Cape Fear coating as well.

On cross-examination, Dr. Thames testified that his visits to Newport were in the months of May and June. He stated that his tests were physical characteristics tests, and did not purport to test for pigment volume concentration. He stated that he did not use field tests on the paint, although such tests may be very helpful. He stated that he left the samples in the salt box for 2300 hours, because it was his objective to destroy the Armstrong paint if he could. He stated that if the substrate had been properly prepared, damage to the paint should have resulted in a minimum of creep.

The next witness was Herbert M. Mandel of Honolulu, Hawaii, who served as Vice President of PARSONS. He had been employed by that firm since 1950, first as a designer, then as a squad leader, then as a project engineer, and finally as project manager. Most of his experience has been with bridges, including the Housatonic River Bridge, the Hackensack Bridge, the Grand Central Parkway Bridges, the Staten Island to New Jersey Bridge, the Fleming Park Bridge in Pennsylvania, a number of bridges on Interstate Route 84, as well as a number of other bridge projects upon which he did work of rehabilitation. Mr. Mandel was project manager for the Newport Bridge, and worked directly under the partner in charge, Mr. Hedefine. Mr. Mandel's job was to organize and supervise the Newport Bridge project, including supervision and inspection of work done by the various contractors. Prior to 1965, Mr. Mandel did not have direct experience with paint systems. His experience was derived under Mr. White. Mr. Mandel participated in the decision of the selection of a coating system for the Newport Bridge. He contributed his own ideas, and sought information through

interviews with knowledgeable people from both BETHLEHEM and American Bridge Company. He participated by way of an extension telephone, in a meeting which took place among Messrs. White, Frye, Spilman of BETHLEHEM, and others, on December 16, 1965.

A few days later, he participated in a discussion with representatives of American Bridge Company in Mr. White's office. Mr. Thatcher of American Bridge Company made a recommendation that a three coat, two component epoxy system should be utilized in coating the bridge.

Mr. Mandel observed the erection and assembly of portions of the suspended span. He walked on the catwalks from time to time. He received numerous reports from Mr. Kinney, the resident engineer. He saw the trusses being assembled. He noted that bare cables or wire rope were being used as straps in lifting the structural members, and as a result, the steel was being abraded in some instances.

Mr. Tidmarch of BETHLEHEM, when confronted with complaints about this type of handling, responded that he had a bridge to erect and he would take care of the paint later. Although Mr. Mandel did not inspect the paint, he did observe its application and observed the structural members being installed.

He was present at a discussion with Mr. Ken Fine of BETHLEHEM, a representative of Armstrong Paint Company and others. Some of this discussion took place in the assembly yard. Large pieces of paint coating could be stripped from a steel member. Mr. Mandel stripped off some pieces and believed he found some oil which had been used in the milling process underneath. He showed this to Mr. Welch and representatives of Armstrong who had it analyzed and found there was a hydrocarbon substance on the underside of the paint film. He observed rusting on the stringer span members. He noted that particles of steel grit had found their

way into the member and then they were painted over. Eventually these particles rusted through. These were not isolated conditions, but represented shop conditions which Mr. Mandel thought should be rectified.

Mr. Mandel was transferred to the Honolulu office during the summer of 1970 and ceased to be project manager for the Newport Bridge at that time.

On cross-examination, Mr. Mandel indicated that the steel bearing plates where he had stripped off paint were ultimately blast cleaned and repainted. He also testified that he had inspected certain of the spans and approved the release of the retainage monies.

He stated that he saw some rust stains at the west abutment and brought some of these to the attention of Mr. Fine, who said that BETHLEHEM would take care of these problems. Mr. Mandel stated that BETHLEHEM may have done so.

He said that the assembly of steel which he observed in the yard was under the supervision of a Mr. Tidmarch. Mr. Mandel did not stop the handling of the steel because there was no actual handling going on at the time of his observation.

He stated that there were portions of the trusses which were unpainted and could be used to attach lifting devices. Also, BETHLEHEM representatives had indicated that softening devices could be used in lifting the steel. Mr. Mandel noted abrasion damage in the trusses after the truss members were installed. He and Mr. Kinney brought this to the attention of BETHLEHEM representatives on the spot. He did not write any letters on this subject.

He stated further on cross-examination that when he left the job in the summer of 1970, he observed the suspended span, and found that considerable areas of paint were in poor condition. He made similar observations in respect to the ap-

proach trusses. At this point he did not write to BETHLEHEM, but the matter was already placed in the hands of an attorney.

He noted that soon after the structural steel began to arrive on the job, Mr. Kinney reported that painting had taken place over mill scale. Mr. Mandel is not trained to detect mill scale visually. He pointed out that if he complains to a contractor and is told by a representative of the contractor, "Don't worry; I'll take care of it," he ordinarily does not worry, but relies on the contractor to take appropriate corrective measures. Mr. Mandel was not aware until the latter part of April 1970 that BETHLEHEM would not take care of these problems.

Mr. Mandel stated on cross-examination that he does not claim to be a paint expert. He relied on the expertise of those in the PARSONS firm or upon outside consultants.

The next witness was Dr. James Scott Long of Clearwater, Florida, who was 82 years of age at the time of his testimony. He received a Bachelor of Science degree and Master of Science degree in the field of chemistry from Lehigh University, and received a Doctor of Philosophy degree from Johns Hopkins University. In addition he has received honorary Doctor of Science Degrees. He has been in the teaching field from 1914 down the present time. He served as a professor at Lehigh University from 1914 until 1934 and as special lecturer at the University of Louisville from 1934 to 1963. He is presently a professor emeritus at the University in Hattiesburg, Mississippi, where he is principally engaged in research.

Over the years he has done consultant work and has published 124 books and articles in various fields. His complete background has been set forth in PARSONS' Exhibit No. 71.

He has done a great deal of research work on the subject of paint and coatings. Since he concluded that linseed oil was

not a good vehicle for exterior paint, he engaged in research work in order to find a more appropriate vehicle. To this end he was employed by the Devoe Paint Company with the understanding that he would bring scientific principles to bear upon the paint business. He discussed the various stages of his research in ether resins and epoxy resins. He believes that a combination of epoxy resins and polyamide oil compounds react well with each other and form the best coating for steel. Professor Long has had a very distinguished career in the paint industry and has received the George B. Heckel Award along with other outstanding awards and citations in this field. He considers his specialty to be epoxy polyamide resins.

Professor Long's first contact with the Newport Bridge problem was on November 17 and 18, 1971, when he visited the PARSONS office. Thereafter, he visited the bridge three times, crossing over the catwalk and viewing the span generally. He noted that the paint had been coming off the steel surface and observed a great deal of rust. He described the condition as very bad.

Professor Long was given a copy of the Newport paint specifications. He has had a great deal of experience in formulating paint, since he was associated with the Devoe Paint Company for twenty-three years. He has also spent a considerable amount of time working on epoxy polyamide coatings. He noted that there are fifteen or sixteen important criteria to be considered in selecting a coating for a bridge. All of these criteria are interrelated.

For example, raising the pigment volume concentration would also raise the viscosity of the paint. This would interfere with application if viscosity became too great. Also, raising the pigment volume concentration would increase the tendency to sag and would lower the gloss of the coating. Raising the pigment volume concentration would interfere

with adhesion or percentage of water absorption. As a consequence, Professor Long believes in a relatively low pigment volume content. He believed that the pigment volume content of the Armstrong paint as prepared for the Newport project was adequate for application on the subject bridge. Although the Newport Bridge is situated in a severe marine environment, the Armstrong specification was excellent for use in such an environment.

On cross-examination, Professor Long stated that he was responsible for bringing Dr. Myers and Dr. Thames into the case, but that he did not discuss their test results. He performed no tests himself. He also stated that at Devoe Paint Company, a civil engineer was employed who set up an elaborate system of tests which a new paint would have to pass before it was commercially sold. However, he indicated that testing would not be the same on a bridge where one contractor and one group of painters would perform the entire job.

The next witness was Frederick W. Ward, Jr., of Weston, Massachusetts, who has been employed at the United States Air Force Bedford Research Laboratories since 1952. He has received Bachelor of Science, Master of Science and Doctor of Science degrees from Massachusetts Institute of Technology in the field of meteorology. He has also done the weather forecast on Television Channel 7 since 1969.

After a great deal of detailed testimony concerning tests which he had of weather conditions at the Newport Bridge and comparing the same with data compiled by Arthur D. Little Company, he concluded that certain portions of the west abutment area were subject to much more rain and drizzle than certain protected portions of the suspended span. Also, portions of the suspended span would be subjected to less wind velocity than certain portions of the west abutment. He also found after making tests for sodium chloride content

that there was no significant difference between the salt deposits on the suspended span and those on the west abutment area.

On both direct and cross-examination, he indicated that the period of fog encountered in Wilmington, North Carolina (where the Cape Fear Bridge is located) was not very different from that encountered in the Rhode Island area if identical terminology were used. For example, in terms of heavy fog, the Providence estimate for 1972 was 26 days, while Wilmington, North Carolina had 23 days of heavy fog. Dr. Ward selected Providence as the nearest weather station to Quonset Point. In the Arthur D. Little report as prepared by Mr. Lindstrom, the term "fog" was used for Quonset Point, while the term "heavy fog" was used for Wilmington, North Carolina. Dr. Ward agreed that the exposed area of the suspended span of the Newport Bridge had the highest wetness reading of all.

The next witness was Marc Herbert Richman of Providence, who has been a Professor of Engineering at Brown University since 1963. He received both his Bachelor of Science and his Doctor of Science degrees from Massachusetts Institute of Technology in the field of metallurgy. He has written over eighty scientific publications, of which two are text books which are in current use in both universities and high schools. He has published materials on the process of oxidation. His background and experience is set forth in full in PARSONS' Exhibit No. 72.

Professor Richman was called by Mr. Dolan, the attorney for PARSONS, on April 1, 1974. He was asked to examine certain paint chips and to analyze a black colored material on the underside or primer side of each chip. He took the chips from envelopes furnished by Mr. Dolan from exhibits which had been marked as exhibits in the case. His samples came from those chips taken by Mr. Buschbom and marked as

Plaintiff's Exhibits 97 through 131. Professor Richman did not identify the black material.

He took each chip, numbered it and prepared a metallographic specimen, and mounted it for observation in epoxy. The mounting would be polished and ultimately used for observation in a metallographic microscope which had been set at a magnification rate of 200.

The photomicrographic results showed that the black material came out of the process light in color because of its light reflecting quality. In each case, the black material, whether thick or thin, faithfully followed the contours of the prime coating of paint. It was Professor Richman's conclusion that the black material was present on the steel at the time the paint was applied, because this would be the only explanation for the matching of the paint contour.

On cross-examination, Professor Richman stated that he did not attempt to identify the black substance, because he was not requested to do so. It was his understanding that the substance had already been identified as mill scale. However, from his analysis, Professor Richman could only conclude that the paint was applied over a black substance which could have been mill scale.

If oxidation or rust had occurred after the paint was applied, the oxidized material would push against the paint materials and would not follow or match the paint contours. It would lift the paint off the surface of the steel.

If the paint were applied to a clean steel surface, and if rust thereafter occurred, it might adhere to the underside of the paint and come off with it. However, it would not match the contours of the paint.

Mr. Sidney Zecher was then recalled in order to give an analysis of the daily logs of Mr. Cox, concerning field painting at the Newport Bridge. These logs were introduced as PARSONS' Exhibit No. 76. He concluded that the total ex-

pended on paint repairs for the years 1968, '69 and '70 amounted to $76,809.

The next witness was again, Bernhard Buschbom. He stated that in the fall of 1966 he was construction inspector of the Cape Fear Bridge and was involved in the field painting during the years 1968 and 1969 on this bridge. He testified that two towers and the lift span were painted with the three-coat epoxy paint system. This was the same coating as the paint used at Newport. Intergard was not used at Cape Fear. He denied the statement by Mr. Manta that repainting had been done. In fact, Mr. Buschbom asserted, extensive repainting was not done at all. Only cosmetic retouching of paint was performed. Mr. Buschbom saw Mr. Manta less than half a dozen times. It was not true that 20 mils of paint were applied. Mr. Buschbom took hundreds of readings at various locations, finding an average of 8 to 9 mils throughout. He took approximately 1,742 readings, and all were taken on May 5, 1974. The specific readings are set forth in a report marked as PARSONS' Exhibit No. 79.

Mr. Buschbom took pictures and slides of the Cape Fear Bridge. The vinyl coating has held up very well but there are a few areas of failure. The three-coat epoxy system has held up well, no underfilm corrosion was apparent. There were some areas where he noted failure and there were some bolt and edge areas which indicated failure. Mr. Buschbom found certain areas of failure in the vinyl coating also, although it was generally holding up very well. He exhibited slides showing the minor failure and rusting in the vinyl area, and also showed motion pictures of the Cape Fear Bridge which had been taken on May 4, 1974, of paint which had been applied in 1968 and 1969. The paint looked very good in his opinion, after five to six years of aging. Very little failure was noticeable, though some areas did show signs of touch-up work.

Mr. Buschbom testified that the Cannon employees began remedial painting on April 12, 1971. He made a motion pic-

ture of the bridge on June 4, 1974, of those portions of the bridge which had been painted by Cannon in 1971. He measured the edges with microtest gauges and other instruments. He stated that Cannon did nothing special in regard to the edges except to remove the BETHLEHEM paint and blast clean to a No. 6 standard, and then apply new paint.

Mr. Buschbom then showed the movie which was marked as PARSONS' Exhibit No. 82. The movie indicated that as of June 4, 1974, the Cannon paint job seemed to be holding up very well. The areas of failure, except for those which have not been remedially painted, did not appear significant as viewed in the motion picture.

On cross-examination, Mr. Buschbom stated that he was the construction inspector at Cape Fear. He performed the inspection in the field once painting had begun. He did not inspect shop painting operations except for one visit. He saw Mr. Manta only half a dozen times in the field.

He stated that he observed no repainting operations on the Cape Fear Bridge except to correct abrasions and construction damage, to cover unpainted areas, and a limited amount of cosmetic touchup. He stated that he was unaware of any hardware store enamel being used on the bridge.

The next witness was Kenneth Fine, who was introduced by way of deposition. He has been employed by BETHLEHEM for 42 years, and is now engaged as General Foreman in charge of Quality Control. From 1965 through 1968 he was Chief Inspector for Quality Control. Among his duties was the inspection of fabricated steel materials.

He was aware that the specifications provided for a commercial blast cleaning of SSPC No. 6 standard. This type of cleaning, he understood, should remove all mill scale and rust except for minor discolorations. He had been furnished with some sample standards to use as a reference. He was not sure whether these samples were made in Pottstown or Chicago. The standard samples which were used are no longer available.

Some problems were encountered in connection with steel grit which was flying around onto painted surfaces. This problem was corrected by installing a canvas cover which was placed around the manual blast booth.

They also encountered temperature problems, because at times the heaters broke down. The heaters were new but mechanical bugs had not all been eliminated from them. These problems were encountered during the cold weather period from December 1966 through January 1967. Occasionally, the steel was painted at temperatures below 40°.

Some of the tower cells were shipped to Newport, and when they arrived, it was apparent in the open air that some grit had been imbedded in the paint. It had been thought that this grit had been removed in the shop. However, the light in the shop was not as good as in the open air.

Mr. Fine exhibited to Mr. White a small grinding tool which would be used to round the edges. The use of this tool was recommended.

A couple of months after December 1966, a storage facility for the painting area was constructed. A special facility with heat was built to store the paint. Mr. Fine was disturbed at the observation of grit getting into the paint. It took a lot of work to remove this grit.

Mr. Fine stated that it is quite possible that there was mill scale on anchorage stiffening bars at one point. During July and August of 1967, there was still a minimal problem with grit.

The next witness was Bob Edward Hanley of Kentucky. This witness was retired but had formerly been employed by PARSONS as an inspector. He had been engaged in this capacity on the 63rd Street Tunnel project in New York. He had also been employed as a paint inspector for the Verrazano Bridge between 1963 and 1965 by another firm.

He started as a paint inspector on the Newport Bridge in 1967, and stayed until 1969. He was the only field paint in-

spector during these years. About ninety per cent of the field painting was done on bare steel which had no shop coat applied. This was true both in 1968 and 1969.

In 1968 and 1969, there was a good deal of abrasion and construction damage noted on the steel structural members. He noted that during 1967 and 1968, much steel had been erected by lifting without the use of softener devices. This gave rise to a considerable amount of abrasion damage. Mr. Hanley complained to Mr. Tidmarch, who was the Project Manager for BETHLEHEM. Mr. Tidmarch said that he had a bridge to build, and would take care of these damaged portions later. Mr. Hanley stated that when BETHLEHEM did repair the damaged areas, they did not do so in accordance with specifications. They did not feather the edges and use other precautionary measures. In 1968 and 1969, they did about one per cent repair painting each year.

In 1968, BETHLEHEM requested a change in the prime coat so they could speed up the operation. In 1970, there were more paint inspectors employed. At that point Mr. Buschbom and Mr. Zecher took Mr. Hanley's place. Mr. Hanley went to the Cape Fear Bridge in North Carolina, where he supervised paint repair work which was made necessary as a result of ship damage. Afterward, Mr. Hanley went to Albany, New York, thence to New York City, where he retired.

In the paint inspection for 1969, Mr. Hanley kept records of the man hours and work performed. Walter Cox was BETHLEHEM's man in charge of the painting work. In examining the Cox reports in the light of Mr. Hanley's own observations and experience, Mr. Hanley computed the man hours for 1968, from logs and based upon his own experiences and observations. He found that 1123 total man hours were expended in the 1968 season, and 5377⅓ man hours were expended in the 1969 season. The precise compilation of man hours for 1968 and 1969 is set forth in PARSONS' Exhibit No. 84.

Mr. Hanley was removed from the Newport job in 1970. He does not know the reason for his removal except that another job was coming up. He stated on cross-examination that he had approved the paint in certain areas up to the east girders. He approved the paint job so far as he observed it. He indicated his approval to Mr. Mandel. He does not know what occurred after this communication.

He looked at about fifteen per cent of the total steel to be erected before it was erected and while it was in storage. The other eighty-five per cent of the structural steel members, Mr. Hanley saw only in the process of erection. He did discern something wrong with the tower cells and trusses in 1967, and reported this to Mr. Kinney. Mr. Hanley does not know what happened after that report. Mr. Hanley had no authority to stop erection. He left the Newport Bridge December 3, 1970, and never returned to the site.

The handling and abrasion damage was the principal cause of the paint failure, in his opinion, at the Newport Bridge. He noted problems with edges where paint was not properly applied. It was his observation that the field painting work was satisfactory. Mr. Hanley anticipated that abrasion damage could be repaired, but not easily. It would be necessary to prepare the surface for application of remedial paint. Where BETHLEHEM did the repairs, they were done properly. BETHLEHEM used wire brushes. BETHLEHEM employees did not stripe the area with a brush and did not cover the whole area which they were supposed to cover.

More than half of the splice plates were painted with the zinc rich primer. This system speeded up the job and looked good.

Cables were used generally to lift the structural members, rather than slings. Mr. Hanley did not know why this was done.

At the beginning of 1970, Mr. Hanley was still the only paint inspector on the job. Later, other inspectors were add-

ed. While Mr. Hanley was still on the job, BETHLEHEM refused to do any further repair work in 1970.

Thereafter, Mr. Sidney Zecher was recalled to give testimony concerning certain repair work which was authorized to the paint job for the year 1970, and also testified concerning an estimate of the cost of work done to repair shop coats for the painting seasons of 1968, 1969 and 1970. As a result of examination of the Cox reports, Mr. Zecher produced an amended figure of $81,346.

The next witness was Mr. Robert B. Roth, who was recalled to rebut certain testimony presented by defendants' witnesses, particularly the testimony of David Innes concerning the use of epoxies to coat certain tanks at International Paper Company. Although Innes had stated that International Paper Company had not used a two component epoxy system, such as was used at Newport, Mr. Roth checked his records in order to determine what types of paint had been applied by his firm at various sites on behalf of International Paper Company.

Mr. Roth testified that tanks were painted with a catalyzed high molecular weight epoxy at an International plant in Mobile, Alabama. A similar specification for paint coating was used for International mill construction at Pine Bluff, Arkansas in 1958 and at Moss Point, Mississippi in 1959. Also, an epoxy type coating had been used for International plants in Louisiana, South Carolina and Arkansas.

Although these latter plants did not use high molecular weight epoxy, a set of specifications issued in 1964 for International Paper Company called for high molecular weight epoxy to be used at mills in Maine, Arkansas, Alabama and New York. He stated that the pigment volume concentration of the first two types of specification constituted about eighteen to nineteen per cent. This contrasted with the Newport pigment volume concentration of about sixteen per cent.

The International specifications called for a prime coat minimum thickness of 1.5 mils, and an overal thickness for all three coats of 7½ mils. This gave rise to an average thickness of 6.2 mils. These specifications called for a two-coat polyamide epoxy.

The specifications in question approved by Mr. David Innes were introduced as Plaintiff's Exhibit No. 247, 248 and 249. All of these specifications provided for a blast clean to an SP No. 6 level. Generally, the Cannon employees cleaned the tanks before applying the paint.

Mr. Roth then discussed the remedial work which had been done by his firm at Newport commencing in April 1971. He stated that around the edges of the failed paint mill scale was found which was visually apparent to the witness himself.

Thereupon, Mr. Roth introduced the original Cannon estimates as to the future cost of painting. This was marked as Plaintiff's Exhibit No. 250. He stated that Mr. Assetto's analysis of the Cannon figures (as shown in Defendants' Exhibit 139) would be the same as Mr. Roth's figures if Mr. Assetto had had the detailed information contained in Plaintiff's Exhibit No. 250.

Mr. Roth stated that he had calculated the projected costs for Phases I, II, III and IV of the remedial work to be done on the Newport Bridge. He indicated that man hours and direct labor costs for Phases II, III and IV, together with other elements of cost, would give rise to an estimated total expense for future work of $2,215,000. These revised estimates of costs were introduced and marked as Plaintiff's Exhibit No. 251.

On cross-examination, Mr. Roth stated that the specifications produced for the International Paper Company jobs were different from the Newport specifications in that the antirust pigment in the International specifications consisted of strontium chromate, where in the Newport specifications

the antirust pigment was red lead. He stated that this was the only significant difference between the two systems.

Mr. Roth stated that he did not analyze or scientifically test the substance which he identified as mill scale. However, in his opinion, a visual examination of mill scale in an appropriate context is a reliable method of detecting that substance.

The next witness was Saul Spindel, who was recalled for further testimony. He referred to the testimony of Dr. Gans, which had been to the effect that the Bradley formulation was foredoomed to failure as a result of its poor pigment volume concentration as well as its poor rust inhibiting qualities. He also referred to David Innes' testimony that the cause of failure was low molecular weight, poor spray characteristics, inadequate rust inhibitors and low pigment volume concentration.

Mr. Spindel stated that pigment volume concentration generally falls in the area of 35 per cent for oil and alkyd finishes. However, the advent of more formidable vehicles, such as epoxy materials, makes a higher P.V.C. recommendation somewhat questionable. The anticorrosive and impermeable qualities of epoxies make it possible to formulate a coating with less P.V.C., but containing as great or greater rust resistance than oil systems which utilize a higher pigment volume concentration.

In an epoxy polyamide system, the epoxy polyamide itself resists corrosion, even without the inclusion of a corrosion inhibiting pigment, such as red lead. Thus the pigment, whether it be red lead or some other type of pigment, is merely an additive to give further assurance against rust and corrosive effects.

Mr. Spindel agreed that the epoxy type paint does tend to thin at the edges of structural steel members, but there are methods to overcome this tendency. Specifications which provide for prestriping the edges are very helpful toward this

end. Also, there was a special body agent, namely Bentone, added to improve the thixotropic qualities of this paint. In addition, the polyamide has outstanding wetting characteristics which should aid in wetting the entire substrate, including the edges.

Mr. Spindel has found no justification in the literature to support the Gans theory that the red lead became encapsulated by the polyamide epoxy and thus was prevented from inhibiting rust. Moreover, Mr. Spindel examined the Newport Bridge on September 5, 1974, with particular attention to twelve areas where BETHLEHEM representatives had removed ten months earlier some twelve samples of paint from the bridge. He saw no evidence of undercutting at these points. He observed no creep of underfilm corrosion in the areas adjacent to those where the samples were taken. The specific areas from which the samples themselves were taken were bare steel, and therefore corrosion had taken place. However, there appeared to be no additional delamination and no further creeping of underfilm corrosion to adjacent areas. He noted that the remedial paint work which had been performed by Cannon employees on the suspended spans appeared to be in excellent condition. There were a few instances of corrosion, but they were insignificant. Mr. Spindel viewed the entire suspended span on September 5, 1974. On the suspended span, considered as a whole, he found less than one per cent corrosion. This suspended span area had been repainted by Cannon.

Mr. Spindel analyzed the P.V.C. for the International Paper Company specifications as set forth in Plaintiff's Exhibits Nos. 247, 248 and 249. He calculated the P.V.C. for the polyamide types, not the polyamine types. The pigment volume concentration for the primer for all three sets of specifications was calculated to be approximately 18 per cent. The Newport P.V.C. was 16.9 per cent.

Two of the International specifications had the same molecular weight. The specifications set forth in Plaintiff's Exhibit 249 showed a higher molecular weight.

Although the anticorrosive pigment utilized in the International Paper Company specifications was strontium chromate, this choice was probably made in order to achieve the desired light gray color. Strontium chromate is less dark in color than red lead. He considered the International Paper Company specifications to be substantially similar, though with some minor variations, to the Newport Bradley coating system.

On cross-examination, Mr. Spindel stated that the 16 per cent P.V.C. provides excellent ability to protect against corrosion. He could not say whether additional P.V.C. would improve the protective qualities. Although a P.V.C. of 35 per cent is most commonly used, it is not necessarily always the most desirable quantity. He further stated that he did not believe that the epoxy utilized in the Newport specifications would be so impermeable as to be capable of encapsulating a pigment in such fashion as to isolate it from the steel.

One would look for failure in the coating system only after ruling out other significant factors such as surface preparation and film thickness as actually applied.

The next witness was Mr. William R. Pressler of Pittsburgh, Pennsylvania. He was employed by the Pittsburgh Testing Laboratories and was currently serving as Assistant to the President. He has served with that company for nearly 49 years. Mr. Pressler is a registered engineer in the State of Pennsylvania. He has served in various capacities with Pittsburgh Testing Laboratories. In 1926 he was in the cement division, then became Branch Manager for the Philadelphia office, then District Manager, and finally in 1959 became Assistant to the President.

He testified that the Pittsburgh Testing Laboratories were formed to do various types of testing in 1881. Since 1959, Mr.

Pressler has been engaged in activities relating to buildings and other structures. Structural steel erection and coatings form a large part of Pittsburgh's activities. The laboratories perform services for owners, architects, state highway departments, engineers, and to a limited extent, for steel fabricators. Most of their work is done for owners or the representatives of owners, such as architects or engineers.

Following a letter of May 19, 1966, from Mr. Mandel (Plaintiff's Exhibit No. 253) Mr. Pressler conferred with Mr. Welch and thereafter submitted a proposal for testing services to be rendered in connection with the Newport project. After additional meetings and correspondence, it was agreed that Pittsburgh would perform spot checking of cleaning and painting of steel structural members at unannounced times. The term "spot check" in the industry indicates that less than ten per cent of all pieces would be inspected. Mr. Pressler instructed his employees to make spot checks on a random basis unless requested to view a particular piece.

On any one shift, the maximum number of inspectors would be three. In some instances there would be less than three inspectors per shift. There were other Pittsburgh inspectors at the Pottstown plant relating to jobs other than the Newport project. These inspectors were not interchanged in function. Only the Newport inspectors would deal with Newport structural members.

Mr. Pressler stated that the Pottstown plant was about 2,000 feet in length. There was another plant nearby of nearly the same dimension, though a little shorter. In December of 1966, Mr. Pressler and John White visited the BETHLEHEM plant, and were shown by Ben Frye a yellow tag procedure which BETHLEHEM proposed to use in order to check off the fact that each member was approved. This procedure was to be jointly accomplished by BETHLEHEM and Pittsburgh personnel.

Pittsburgh Testing personnel would inspect welding for defects on approximately a one foot for each ten feet basis. On the half dozen occasions when Mr. Pressler was present, he could not observe the number of inspectors who were used by BETHLEHEM on any particular shift. The inspectors on each shift would make a random check on welding and assembly. It could not be expected that one or two men could cover this huge plant. It was also anticipated that BETHLEHEM inspectors were supposed to check materials before the Pittsburgh inspectors did so. After examining the series of 60 tags contained in Defendants' Exhibit No. 37, Mr. Pressler found that Pittsburgh personnel signed seven such cards.

On cross-examination, Mr. Pressler stated that he visited the Pottstown plant about six times. On these occasions he was not there to perform the function of an inspector. The inspectors were under the supervision of the Philadelphia office of Pittsburgh Testing Laboratories. Mr. Glaser was the chief inspector on the Newport project. Mr. Pressler stated that he never performed any inspection function on this job himself. He stated that pieces about to be shipped would be marked with a red tag by the Pittsburgh Testing Laboratories' personnel. This tag released the item for shipment, but would not necessarily indicate the item would be acceptable to the client.

Thereafter, Mr. Saul Spindel was recalled and commented upon the testimony of Dr. Gans in respect to a statement that it would be impossible to achieve 6 mils of coating on edges without getting 30 to 40 mils on other areas. Mr. Spindel conducted an experiment on panels which were first blast cleaned, then striped on edges, and thereafter three coats were applied to the twelve panels in four groups of three.

As to Group 1, 2 mils per coat were applied, or a total of 6 mils of coating.

As to Group 2, 2.6 mils per coat were applied, or 8 mils of total coating.

As to Group 3, 3.3 mils per coat were applied or a total of 10 mils of dry film thickness.

As to Group 4, 4 mils per coating were applied, or 12 mils of total dry film thickness.

Mr. Spindel measured the wet film and also the dry film thickness by a magnetic device. Three or four readings were taken for each panel. He measured the primer coat and the other coats individually. As to Group 1, the primer coat ranged from 2.0 to 2.3 mils in thickness. The intermediate coat ranged from 2.7 to 3.0 mils in thickness. The top coat ranged from 2.3 to 2.5 mils in thickness. The total covering ranged from 7.0 to 7.5 mils.

As to Group 2, the total thickness ranged from 8.5 to 8.6 mils total for the three coats. As to Group 3, the total thickness ranged from 10.0 to 10.3 mils for the three coats. As to Group 4, the total thickness for the three coats ranged from 12.5 to 13.0 mils. A table of film thickness and test results prepared September 4, 1974, was introduced as Plaintiff's Exhibit No. 259.

Mr. Spindel sent these panels to Dr. Baier with instructions to measure the thickness on the edge of each panel from 1 to 12, without any other comment.

On cross-examination, Mr. Spindel stated that all panels were sprayed, that he had his measurements taken by September 4, 1974, and received the data from Dr. Baier subsequently. The plates chosen were one quarter inch thick; this seemed to be a convenient thickness for experimental purposes.

The next witness was Robert E. Baier of Buffalo, New York, who was employed by Cal Span Laboratories. He had formerly been employed at the Cornell Aeronautical Laboratory of Cornell University. He received degrees of Bachelor

of Arts in Engineering Science in 1962 from Cleveland State University, and a Ph.D. in Physics from the State University of New York. He is a professional engineer and a certified professional in the field of chemistry. He is a member of the American Chemical Society. His specialty is surface chemistry, which deals with thin coating films and boundary phenomena. This laboratory is highly specialized in thin films ranging from layers of a few molecules to layers of several mils in thickness. Dr. Baier's curriculum vitae was introduced as Plaintiff's Exhibit No. 260.

Dr. Baier received the samples from Mr. Spindel of Litter Laboratories with verbal instructions to measure the thickness of the film at the edge and on the surface of the panels in other zones than the edges. To this end he used a scanning electronic microscopy device. In connection with this device he used a previously calibrated measurement rule. In measuring the 12 panels' thickness, his findings ranged from 4 to 6 mils at the thinnest areas on the corners of edges and from 7 to 16 mils on the flat areas away from the edges.

His test electron photographs as to all 12 panels were fully set forth in Plaintiff's Exhibit 261 (1) through (31). Dr. Baier achieved a slightly thicker film reading than Mr. Spindel had found, but this difference reflects the difference in method used.

On cross-examination, Dr. Baier stated that his general field of expertise is not paint, but general surface chemistry. He stated that it would not be necessary to build up a flat area coating beyond 8 or 10 mils in order to get 6 mils at the edges. He further stated that if one built up 20 or more mils on a flat area, one might still not get much more than 6 mils at the edge because of the characteristics and behavior of the paint. It seemed to be a characteristic of this type of paint that its thickness would be limited to about 6 mils at the edge.

The next witness who dealt with the paint problem was Ernest Winford Glaser, Jr., of Harrisburg, Pennsylvania. He has been employed by the Pittsburgh Testing Laboratories for 16 years. Of this time he has spent 11 years at BETHLEHEM as a Class A inspector.

Mr. Glaser was the chief inspector on the Newport job with seven inspectors under him. There were four inspectors, including Mr. Glaser, on the day shift. On the 3 to 11 p.m. shift there were two inspectors, and also two inspectors on the 11 p.m. to 7 a.m. shift. Two of these inspectors are now dead. The others are either serving with other companies or are retired.

Mr. Glaser stated that there are several large shops at Pottstown, each containing different operations. The east shop had the Wheelabrator, cutting, drilling, cleaning and painting operations. Mr. Glaser's inspectors concentrated on the fit-up and welding as the most critical of all operations. He made about four to five reports each week on several operations, including painting. He would spend two to three hours per day in the inspection of operations in the plant. The balance of his time was spent on administrative matters.

About ten per cent of the structural steel was inspected for surface preparation and painting. This was a spot-type inspection. He estimated that about 10,000 pieces were shipped out of the Pottstown plant. Of these 10,000 pieces, about 800 pieces were the subjects of Mr. Glaser's paint reports.

In addition to the Newport project, Pittsburgh employees were also inspecting materials for an Albany Mall job which was being fabricated at the BETHLEHEM plant, plus one other job as well. There was no interchange of function between these two inspectors. He stated unequivocally that the Pittsburgh inspectors did not inspect every piece of steel as Mr. Tevelson had indicated in March of 1974. Mr. Glaser's men did not inspect the steel before yellow tags were affixed,

except on a spot-check basis. Mr. Glaser's men did not decide or control whether yellow tags would be affixed or not to the structural members. Mr. Glaser also examined the yellow tags admitted as Defendants' Exhibit 37. Of these a few bear Pittsburgh inspectors' initials. These tags were promulgated by Mr. Ken Fine, who was the chief inspector of BETHLEHEM on this job. Mr. Glaser reviewed his paint reports which were a part of Defendants' Exhibit No. 38 in order to consider the number of pieces which were involved. The yellow tags did not purport to deal with the quality of surface preparation but only with the coat of paint. The Pittsburgh red tag was placed on each large piece or bundle of small pieces before shipment. This was done after a visual inspection. It did not indicate that any prior inspection of intermediate processes had been made.

Mr. Glaser stated that of the two evening inspectors and night inspectors, only one each was assigned to the east shop where cleaning took place. There was no painting on the evening or night shifts.

On cross-examination, Mr. Glaser stated that he had learned the inspection trade at the BETHLEHEM plant. He stated that he was chief inspector on the Newport job from the beginning of the project in 1966 to 1968. He had been assigned as an inspector at the Pottstown plant for ten years prior to the commencement of the Newport job. He stated that he did not recall any complaints about inspection service holding up production. He believed that he had an adequate number of inspectors.

Mr. Glaser expressed no opinion as to the yellow tags. He did not tell his inspectors not to sign the cards. He told them to sign the cards if they had actually inspected the work. If an adverse report were to be made, the inspector would put it in his log. The BETHLEHEM foreman would also be notified. The Pittsburgh inspectors tested thickness of paint, of both wet and dry films, using appropriate instruments or gauges.

Mr. Glaser also testified on cross-examination that no material was supposed to leave Pottstown without a red tag. Pittsburgh inspectors checked the painting conditions such as temperature in the shop and took paint samples to send to the home office of Pittsburgh for further testing. They also checked the storage of paint and the conditions of application. Mr. Glaser and his inspectors spot checked the manual blasting, including the Pangborn Rotoblast machine and the Wheelabrator. He stated that he and his men inspected the welding operations. At this point the steel had already been cleaned once. There would be a post welding cleaning as well. He stated that if mill scale had been on the steel it would have been readily visible at this point. His subordinates would not knowingly have allowed improperly prepared material to leave the BETHLEHEM plant.

The next witness on the subject of paint was Mr. Bernhard H. Buschbom, who was called in rebuttal for the purpose of presenting a motion picture which had been taken of the Newport Bridge on November 19 and 22, 1974. This motion picture was introduced as Plaintiff's Exhibit No. 340, and showed that the paint which had been applied by Cannon from two and a half to three and a half years previously was in very good condition. Very little rust or corrosion was visible in this picture.

Thereafter, Mr. Richard Lindstrom was recalled to rebut testimony which had been given by Dr. Baier. Mr. Lindstrom examined the flat bars from which Dr. Baier had prepared his specimens for the Spindel analysis. Mr. Lindstrom cut areas from these bars adjacent to where Dr. Baier had gotten his samples. Mr. Lindstrom took photos of the paint thickness and measured the edges from 3.5 to 5 mils. Baier measured from 7 mils to 15 mils on the flat surfaces. Mr. Lindstrom's readings on the flat surfaces conformed, but not as to the edge surfaces. He stated that Dr. Baier's technique was not

as accurate because his specimens were not cleaned of debris from the sawing process. Also, Mr. Lindstrom used a 60 power magnification rather than a 30 power magnification as utilized by Dr. Baier. These photographs were introduced as Defendants' Exhibit 303 (1) through (21), Defendants' Exhibit 304 and Defendants' Exhibit No. 305. The twelve specimens taken by Mr. Lindstrom from the Baier samples were introduced and marked as Defendants' Exhibit 306 (1) through (12).

It was pointed out on cross-examination that Dr. Baier used a scanning electronic microscope, where Mr. Lindstrom used a straight or ordinary microscope. Mr. Lindstrom polished certain edges to a slight bevel with light abrasive paper.

The next witness on the paint subject was Edward T. Peters, who performed ten x-ray diffraction tests of chips from various bridges taken by Mr. Lindstrom. A number of samples showed FeO or wustite taken from various bridges.

On cross-examination, the witness stated that he did not know if these samples were taken from failed areas or not. He also did not know whether FeO would be more likely to remain in an area where paint had not failed.

Findings of Fact and Conclusions of Law Relating to the Paint Controversy

Thus far, the Court has purported to summarize only the testimony relating to the controversy concerning the application of paint to the Newport Bridge. This controversy is quite separable from the claim made by BETHLEHEM Steel Company concerning losses incurred by it as a result of delays in construction schedule allegedly caused by the AUTHORITY, its engineers, or other contractors. It seems appropriate to deal with these subject matters separately and to make findings of fact and conclusions of law on the paint claims before

reaching the controversy concerning the delay in construction.

Beginning in January, 1974, the trial began with the showing of motion picture films. Plaintiff's Exhibit No. 11 was a motion picture taken in 1970 which showed the condition of the paint on the suspended spans prior to the beginning of remedial work. Plaintiff's Exhibit No. 12 was a motion picture of the Cannon remedial work which had been completed as of November 2, 1973. PARSONS' Exhibit No. 82 was a motion picture taken on June 4, 1974, showing the 1971 Cannon remedial work and its condition at the time of the taking of the motion picture. Plaintiff's Exhibit No. 340 was a motion picture film taken of the entire Cannon remedial work on November 19 and 22, 1974, near the conclusion of the presentation of evidence.

From the evidence which has been summarized above and from the motion pictures and slide pictures which have been introduced into evidence, certain facts seem beyond dispute. Both parties agree that by 1970, catastrophic failure of the paint applied by BETHLEHEM to the suspended span had become apparent. All witnesses on both sides of the controversy seem to be in agreement that this failure was of a type which exceeded anything in their previous experience. The sole controversy between the parties is as to whether this admittedly catastrophic failure was due to faulty application or surface preparation prior to application of the paint, or whether it was due to the inherent deficiencies of the paint specifications themselves. This case has truly been a battle of experts.

A number of distinguished experts who have been referred to in the testimony summarized above, have testified that the paint specified in Section 7 of Contract No. 3 was most adequate as a protective coating for the steel to be erected at the Newport site. These specifications were prepared by Mr.

White of PARSONS after consultation with Mr. Bradley, Ben Frye of BETHLEHEM, and a number of other individuals who were expert in the selection of appropriate coatings for steel surfaces. Although it is true that this specific type of epoxy formulation had not been previously utilized on a bridge structure, it had been used as a coating for ships and other types of marine structures where environmental exigencies of a similar type would be encountered. Dr. James Scott Long, for example, considered this specification as excellent for the Newport marine environment.

The paint was ultimately tested by David Litter Laboratories and found to be adequate for the purpose intended. It was also tested by salt fog exposure which simulated conditions which might be expected in the Newport environment and found to withstand these tests as well as or better than all other systems which were then known to the art.

It is also true that the defendant presented testimony which indicated that the coating specified by PARSONS was not adequate to the task, that it had not been appropriately tested prior to use. Mr. Lindstrom and other witnesses indicated that this paint was inherently defective in that it did not have a sufficient pigment volume concentration in order to inhibit corrosion, and that there was a tendency on the part of the epoxy so to encapsulate the red lead primer component as to reduce or even eliminate its effectiveness.

Viewing the testimony as a whole, in the opinion of the Court the witnesses presented by the AUTHORITY and PARSONS were better qualified and more experienced in the subject of coating for steel surfaces than the principal witnesses presented by BETHLEHEM. The only exception to this general status of qualifications was Mr. Ben Frye, whose testimony to a great extent supported the position of the AUTHORITY and Mr. White of PARSONS, that he had gone over these specifications initially in answer to a memo

written to him by Mr. White. Had the specifications been so inherently and obviously defective as was indicated by certain of BETHLEHEM's witnesses, Mr. Frye would have been in a position to point this out very quickly.

Perhaps the most persuasive element which favors the case presented by the AUTHORITY and PARSONS is the actual condition of the specified paint as applied in the remedial work done by Cannon. No one could view the motion pictures taken in 1974 without noticing the dramatic difference between the condition of the paint as applied by the Cannon employees and that which had been applied by BETHLEHEM in its Pottstown plant. It is true that an occasional slight element of corrosion may be noted, but overall the paint applied by Cannon is holding up extremely well under the same environmental conditions which were applicable to the BETHLEHEM applied paint.

It has also been agreed by all of the witnesses that this epoxy formulation developed in the Bradley specifications required an extremely careful job of surface preparation. It was pointed out by a number of witnesses that the conventional linseed oil and red lead combination would penetrate mill scale or other contaminants and adhere to the substrate of the steel. However, the epoxy coating formulated by Armstrong under the concept submitted by Mr. Bradley required a thorough cleaning and surface preparation of a quality equal to the SSPC No. 6 standard.

It is very clear from the evidence that the AUTHORITY and PARSONS presented a large number of witnesses who were highly skilled in the specialty of paint and coatings for steel surfaces. Perhaps the most experienced and qualified witness presented by any side was Dr. James Scott Long, who might well be termed the father of epoxy coatings. Dr. Long had been engaged in the formulation of epoxy polyamide coatings for more than 25 years. He stated unequivo-

cally that the Section 7 specifications were not only adequate, but would form an excellent coating for a bridge located in a severe marine environment. It is also quite significant that a number of witnesses for the AUTHORITY and for PARSONS testified that the blue-black material which was apparent and visible on the underside of the hundreds of paint chips which had been taken from the bridge, followed exactly the contour of the paint.

Dr. Marc Richman, Professor of Engineering at Brown University, stated unequivocally that the black material conformed precisely in contour to the primer coat of paint, and that the pores and gaps in the black material were filled by the primer. He therefore concluded that this black material had to be on the surface of the steel to which the paint had been applied. This opinion was shared by Dr. Myers, who also identified the material as mill scale There was also a considerable amount of further evidence which indicated that the steel structural materials had been abraded and mishandled during the process of construction, and that these defects were brought to the attention of Mr. Tidmarch by Messrs. Kinney, Mandel and Hanley.

There are also memoranda which passed between Mr. Fine and Mr. Taylor (PARSONS' Exhibit No. 15) which indicated that considerable difficulty was encountered in the utilization of blasting equipment due to breakdowns and frequent changes in personnel. PARSONS' Exhibits No. 18 and 19 are also interoffice memoranda which buttress the same conclusion. The Court therefore finds as a fact that the BETHLEHEM surface preparation prior to the application of paint to the structural steel members was inadequate, and in many instances did not achieve the SSPC No. 6 standard.

The defendants' witnesses on this subject, notably Mr. Lindstrom and Dr. Gans, really attempted to create doubt as to whether the blue-black substance constituted mill scale or

some corrosive product. The chief element in this contention was the absence of the compound FeO or wustite, which is conceded to be a component of mill scale as it is originally formed at high temperatures.

However, it was also pointed out that FeO is a very unstable compound and might well disappear in the open air after a period of time. Also, due to the tendency of mill scale to delaminate, it is probable that wustite or FeO portions could remain on the surface of the steel when the paint chip was removed. However, the Court finds it most significant that the black substance Fe_3O_4 was found by several witnesses to have been present on the steel at the time of the application of the primer coat of paint at the Pottstown plant.

Although the plaintiff AUTHORITY has the burden of proving by a fair preponderance of evidence that the paint failure was due to a faulty preparation of the steel by BETHLEHEM in that mill scale and other contaminants were not removed to an SSPC No. 6 level prior to the application of paint, it is not necessary that the plaintiff prove beyond a reasonable doubt that the contaminant in each instant was mill scale. The Court finds that the plaintiff has proven by a fair preponderance of the evidence that contaminants were present on the steel at the time of painting and that such contaminants in most instances were probably mill scale or a residuum thereof.

The attempt on the part of the defendant to show through its witnesses that the Section 7 specifications were inherently inadequate was a complete failure. The testimony of Dr. Long, Sidney Levinson, Saul Spindel, Dr. Thames, and a number of other witnesses, indicated that the paint specified by Mr. Bradley for the Newport Bridge was of excellent quality and is quite adequate, where properly applied, to provide a suitable coating for a bridge structure in the Newport environment.

Even if one were to doubt the impressive expertise of these witnesses, it is quite significant that Seymour "Ben" Frye, who was the outstanding coatings expert of the Homer Research Laboratories of BETHLEHEM Steel Company, had himself examined these specifications prior to the bid by BETHLEHEM and had recommended the epoxy formulation and suggested the prestriping element which was eventually included in the specifications. It is also significant that Mr. Frye in his court testimony in Volume 23, pp. 76 and 77 of the transcript, agreed that he had studied the Section 7 specifications prior to the bid and that he had written a memorandum to Mr. Assetto on February 25, 1966, in which he indicated a belief that the epoxy formulation detail was satisfactory.

This is in significant contrast to the testimony of Dr. Gans, a witness for BETHLEHEM, who in answer to a question by the Court indicated that practically any paint expert worth his salt would have detected a P.V.C. (pigment volume concentration) problem just as fast as he would have (Volume 24, page 31 of the transcript).

However, the most persuasive indication that the Section 7 specifications were adequate if proper surface application and preparation were accomplished is the record of durability of the identically specified paint as applied by Cannon employees and as indicated by motion pictures taken as recently as November 19 and 22, 1974 (Plaintiff's Exhibit 340). This is further buttressed by both pictures and eye witness testimony concerning the adequate durability and performance of this paint on the west abutment area and steel towers of the bridge as applied by BETHLEHEM, and on the Gammino Bridge as applied by another painting contractor using identical specifications.

Although the condition of the Cape Fear Bridge has been open to some dispute, particularly by the testimony of Mr. Manta, the preponderant weight of the testimony concerning

the Cape Fear Bridge would seem to indicate that the Section 7 type specification has performed adequately in that area as well.

From the meteorological evidence presented in the case, the Court is completely unpersuaded that the distinction in durability of the paint on these various subjects could be explained by a difference in the marine environments involved. The steel towers are in an environment which might be described as identical to the suspended span. The west abutment and the Gammino Bridge are separated by a minimal distance from other areas of the Newport structure where failure has been massive. The Court can place no significant weight upon these alleged geographical factors.

Thus, the overwhelming weight of the testimony shows almost beyond doubt that the paint as specified for the Newport Bridge in Contract No. 3 was adequate for the purpose intended and that the massive failure which took place by 1970 was due to faulty surface preparation and/or application on the part of BETHLEHEM, its employees and agents. As a consequence, BETHLEHEM is liable for the reasonable cost of remedial painting which was necessitated by its failure to perform its contractual obligations.

The testimony as to the cost of remedial painting indicated that Mr. Zecher of PARSONS carefully selected a painting contractor who had the requisite qualifications to perform the necessary blast-cleaning operations and application of the specified epoxy paint system on a bridge structure which had already been erected. Mr. Robert B. Roth, President of Oliver B. Cannon & Son, Inc., which was the company selected to perform this work, testified at length concerning his examination of the work, and his experience in performing the remedial painting of the suspended span which was referred to as Phase I. Although Mr. Roth anticipated that only a portion of the paint would need to be sand blasted and removed,

experience in the field indicated that the blasting of obviously loose paint created or exposed adjacent loosening of paint in the area were the work was performed. Consequently, after every reasonable effort, it became apparent that nearly all of the paint needed to be removed before remedial painting could effectively take place. He visited the bridge on May 6, 1971, and found the extent of failure was well beyond that which he had visually observed. He looked at paint chips and saw what he believed to be mill scale underneath. He then concluded that the paint failure on this structure approached 100 per cent. He estimated that the Phase II area consisting of the east truss portion would require that 85 per cent of the coating would need to be removed. He estimated that for Phase III, the west truss areas, 80 per cent of the paint coating would have to be redone. On the basis of a recent inspection of the Phase IV area, he estimated that a lesser percentage of paint removal would be required.

Taking into account labor, materials, equipment, supervision and other expenses, the following figures were reliably determined for work which had been performed and which would be required to be performed in order to complete the remedial painting: Phase I, $2,342,370.63 for remedial painting costs already incurred and paid, from 1971 to 1973. Also in connection with Phase I, $232,037 was paid in engineering costs from 1971 to 1973. For Phases II, III and IV, as set forth in Plaintiff's Exhibit No. 250, a total future cost of remedial painting was estimated at $2,215,000. For these same estimated costs of remedial painting, an additional charge of $275,000 for engineering costs was estimated.

In the opinion of this Court, the fair preponderance of the evidence supports the finding, which this Court now makes, that these costs, both incurred and estimated, were and are reasonable in amount, and reasonably necessary in order to restore the bridge to the condition in which it would have

been had BETHLEHEM appropriately carried out its contract obligations. Thus the AUTHORITY would be entitled to recover the sum of $5,064,407.63 from BETHLEHEM for breach of its obligation to prepare the surface of the Newport Bridge structure appropriately prior to painting the same and for the massive and catastrophic paint failure which resulted from said breach.

The Counterclaims

It is now necessary to consider the counterclaims which BETHLEHEM has set forth against the AUTHORITY and PARSONS. The first count of the counterclaim by BETHLEHEM seeks to recover from the AUTHORITY the sum of $811,661.27, which represents the unpaid balance of the contract price between the parties. It has been agreed by the parties (page 16 of Volume 22 of the transcript) that the sum of $804,996.55 has not been paid by the AUTHORITY to BETHLEHEM under the terms of the contract price. Therefore, it is obvious that the AUTHORITY's right to recover from BETHLEHEM must be reduced by said sum.

The second count of the counterclaim seeks to recover on behalf of BETHLEHEM from the AUTHORITY and PARSONS jointly and severally the sum of two and a half million dollards by virtue of additional work required as a result of inadequate paint specifications set forth in Contract No. 3. The Court's finding as a matter of fact that the paint specifications in Section 7 of Contract No. 3 were adequate and suitable for the purpose for which they were intended, disposes of this count of the counterclaim. Therefore, the Court holds that BETHLEHEM is entitled to recover nothing by virtue of Count 2 of its counterclaim.

Findings of Fact and Conclusions of Law as to the Delay Controversy

We shall now consider the third count of the counterclaim under which BETHLEHEM seeks to recover approximately four and a half million dollars as a result of delays in construction as a result of the unavailability of certain piers and towers on the dates when such piers and towers had been scheduled for work by BETHLEHEM in its initial contract documents.

Essentially, it is the claim of BETHLEHEM that the AUTHORITY agreed to complete tower piers 1W and 1E on or about October 30, 1966, and cable bent piers 2W and 2E and anchorage piers 4W and 4E on or about January 30, 1967. BETHLEHEM further claims that its performance of its work under the contract was dependent upon the completion and availability of the aforementioned piers on or about the dates as represented. The failure of the AUTHORITY to bring about the timely completion of such piers caused the work progress schedules that BETHLEHEM had prepared to be altered and delayed.

There is no question that the substructures of the main tower piers of the Newport Bridge were constructed by the Perini Corporation, which began preliminary work in the fall and winter of 1965 and 1966 in surveying, test borings and the like. In January of 1966, Perini contracted with BETHLEHEM for the fabrication of footing boxes and shafts, as well as pilings which would be used at towers 1E and 1W. During the late winter of 1966, test pile driving began at tower 1E and certain problems were encountered in achieving the desired friction bearing at an anticipated depth of 60 feet below the bottom of the bay. Thus, the test pile program was continued and finally a sufficient friction was achieved at a depth of 90 feet below the bottom of the bay so as to allow the friction-bearing piles to support the necessary weight.

The contract with BETHLEHEM was entered into on April 25, 1966, concerning construction of the superstructure of the bridge, which was to be BETHLEHEM'S portion of the work. The initial contract with Perini Construction Company relating to piers 6W through 4E was entered into on or about October 22, 1965. This was approximately six months before the BETHLEHEM contract was awarded. Thereafter, on September 26, 1966, the Perini contract was supplemented by the addition of construction to be done on the substructures of piers 5E through 41E. A contract for piers 7W through 13W was awarded to the Gammino Construction Company at a later date, and a contract for concrete work was awarded to Coleman Brothers Corporation on March 9, 1967.

The detail and the complexity of the factual testimony of the principal witnesses regarding prosecution and defense of BETHLEHEM'S counterclaim based upon the delay and nonsequential availability of the various piers is such that the Court will not attempt to summarize the testimony of each witness in detail as it has done in respect to the paint controversy. Rather, the Court will state the facts as it has found them to be from the testimony of the principal witnesses relating to the delay controversy. These principal witnesses were Mr. Valentino J. Assetto and Thomas J. Elder on behalf of BETHLEHEM, and Mr. Herbert M. Mandel of PARSONS, Mr. Sidney Zecher of PARSONS, and Mr. Charles A. Richardson of Perini Construction Company, who testified on behalf of the AUTHORITY. In addition, correspondence between various representatives of BETHLEHEM, PARSONS and the AUTHORITY will be referred to, as well as certain excerpts from the diaries of Mr. Kinney. However, in order to preclude adding unduly to the already considerable length of this decision, the Court will state the facts as it found them to be in a narrative form, as briefly as the subject matter will permit.

The major piers which are the subject of the BETHLEHEM delay claim are piers 1W, 1E, 2W, 2E, 4W and 4E. Indeed, it was not known until April, 1974 that BETHLEHEM was relying upon late delivery of piers other than the six adverted to. These six piers had been set forth in answers to interrogatories as those which were not delivered on time in accordance with construction schedules, and which therefore gave rise to the additional cost and expense incurred by BETHLEHEM. This additional cost and expense, though stated in various sums at varying times, was set forth on January 5, 1973 as totaling $5,670,437 in damages. In April, 1974, BETHLEHEM introduced over strong objections its Exhibit No. 144, which sets forth in detail the basis of its claim under Items "A" through "P" in a total sum of $4,918,538.

The Court will now recite the chronology of events which led up to this claim. From the beginning of the project, with the test driving of friction bearing piles, the Perini Construction Company (hereinafter referred to as "Perini") encountered a number of difficulties. Some of these difficulties arose as a result of accidents on the job, such as the loss of a pile driving platform at Pier 1W. Some arose as a result of severe storms encountered in the Narragansett Bay area during the period of construction. Some resulted from the method of construction used, namely, the tremi-pour construction of certain of the concrete substructures. At certain of the piers, such as Pier 4W, Perini poured concrete by the tremi method into forms which had not been pumped dry. Under this method the concrete would displace the water and ultimately a foundation would be erected upon which a more traditional dewatered cofferdam would be constructed for the building of the remainder of the substructure.

In certain instances, difficulties were encountered with the tremi pour, and probably insufficient amounts of concrete

were poured in the wet in order fully to accomplish the purpose of creating the appropriate substructure.

These difficulties were countered by attempting to pour additional concrete and by pressure grouting. In some instances, shortages in the amount of tremi-poured concrete had to be made up or compensated for by placing additional concrete in the wells of the anchorages.

As a result of these and other difficulties, too numerous to recount, the availability of the six major piers was delayed for varying periods.

In the initial contract documents, a clause was included which advised BETHLEHEM that Tower Piers 1W and 1E were "scheduled" for completion "about" October 30, 1966. It was also stated that Piers 2W, 2E and Anchorage Piers 4W and 4E were scheduled to be completed "about" January 30, 1967. At the time of the BETHLEHEM award of Contract No. 3, contracts had not been let for the other piers.

In about December of 1966, BETHLEHEM presented to representatives of PARSONS a construction schedule which has been referred to as CS-1 which set up a timetable for completion of its work, assuming the availability of the major piers as indicated above. However, about this time it was apparent to any casual observer that the piers which had been scheduled for completion by October 30, 1966, had not been completed. Therefore, coincidentally with the presentation of CS-1, BETHLEHEM representatives presented to the engineers another construction schedule, CS-2, which took into account certain delays which by then had become apparent to all.

At first representatives of BETHLEHEM did not participate in the weekly progress meetings which were held between and among representatives of the engineers, the AUTHORITY, and the various contractors. The BETHLEHEM personnel began to arrive on the field in October of 1966. Ap-

parently, BETHLEHEM representatives took part for the first time in a progress meeting on January 5, 1967. Pier 1E was made available to BETHLEHEM on April 20, 1967 for bush hammering and Pier IW was made available for grinding on May 18, 1967. By this point, it had become apparent to all that three or four months of delay in the availability of these critical piers had been encountered.

In order to consider the problems of delay and an appropriate response thereto, a meeting was held at the office of the AUTHORITY on May 15, 1967, attended by Messrs. Shaw, Jones and Gearhart of BETHLEHEM; the AUTHORITY Chairman, Mr. Dwyer; its Executive Director, Mr. Canning; and also by Mr. Kinney as resident engineer for PARSONS. At this meeting the BETHLEHEM representatives submitted a revised construction schedule, CS-2 R3, dated May 11, 1967 (Defendants' Exhibit No. 177). This new schedule contemplated a completion date for the construction and assembly of the suspended steel portion of the bridge of November 7, 1968. This would probably have meant that the bridge would not open until midsummer of 1969.

Mr. Dwyer and Mr. Canning expressed concern about the probable delay in the opening of the bridge. This concern was based upon the desire of the AUTHORITY to begin achieving revenues from bridge traffic as soon as possible to counteract the expenses of interest and amortization upon the bonds which had been issued in order to finance the construction of the project.

Thereafter, a letter was prepared by BETHLEHEM on May 23, 1967 (Defendants' Exhibit No. 179). In effect, this letter requested an extension of six and a quarter months of the BETHLEHEM completion dates because of the unavailability of the various tower piers. This letter also indicated that BETHLEHEM would make a claim for additional expenses which would be detailed in later correspondence as a

result of the delays experienced in its performance of the project. BETHLEHEM also made it clear in this letter that if there were to be any acceleration of this proposed schedule, it would be subject to negotiation and substantial additional cost. This letter was prepared by Mr. Elder and signed by Mr. C. W. Pitchford, who was then the District Manager of Erection for the East Coast District.

Following this letter a meeting was held at the PARSONS office in New York on June 7, 1967. Mr. Elder prepared a memorandum of that meeting of June 7 which was introduced as Defendants' Exhibit No. 180. There were present at that meeting Mr. Canning and Mr. Harvey on the part of the AUTHORITY; Mr. Dalby, Mr. Gearhart, Mr. Pitchford, Mr. Elder and Mr. Shaw on behalf of BETHLEHEM; and Messrs. Hedefine, Mandel, Zecher and Kinney on behalf of PARSONS.

The general subject matter of this meeting was to seek a method by which time lost in the construction of the bridge due to the pier availability delays might be recaptured. It was apparently suggested at this meeting that an attempt would be made to complete the superstructure of the bridge by August 15, 1968. It is noteworthy to contrast this proposed date with the initial date of completion of April 30, 1968, as set forth in Construction Schedule No. 1, and the date set forth in Construction Schedule No. 2, Revision 3; namely, November 15. This would have achieved an acceleration of approximately three months over the then anticipated CS-2 R3 date.

After a considerable discussion and conference among the BETHLEHEM officials, the representatives of that firm attended a meeting at the PARSONS office in New York on June 20, 1967, at which meeting they presented Construction Schedule No. 4, dated June 17, 1967. At this meeting were representatives of BETHLEHEM, PARSONS, the AUTHOR-

ITY and also representatives of the financial advisors to the AUTHORITY from Dillon, Reed & Company and J. Tripp & Company. At the June 20 meeting, BETHLEHEM presented two letters. The first letter is Plaintiff's Exhibit No. 200 and is a follow-up to the BETHLEHEM letter of May 23, 1967, in which a claim was made for costs incurred as a result of delay. The cost set forth in this first letter of June 20, 1967 as having been incured to date as a result of delay was $171,856. In this letter BETHLEHEM made formal claim for payment of said sum.

Representatives of BETHLEHEM also presented to the AUTHORITY a second letter dated June 20, 1967, which was introduced as Plaintiff's Exhibit No. 201, which also dealt with the general claim letter of May 23, 1967. However, in this letter BETHLEHEM indicated that if certain acceleration programs were adopted as set forth in Plaintiff's Exhibits No. 202 and 203, the claim for losses incurred to date would be diminished to $96,271. However, the adoption of the accelerated program would require additional payments to BETHLEHEM, including the back charges for delay, as well as equipment rental charges, additional shop charges, land rental costs and the like, which would total $468,971.

There were thus presented to the AUTHORITY two alternative courses of procedure. It might adopt the accelerated program by making an additional payment of $468,971, including back charges for delay in the amount of $96,271, or it might decline to accelerate, accept a delay in the opening of the bridge until sometime in 1969, and consider the claim of BETHLEHEM in the amount of $171,856.

Apparently, the AUTHORITY and its financial advisors considered the advantages of the earlier opening of the bridge to traffic as worthy of the additional cost to be incurred. As a consequence, the AUTHORITY notified BETHLEHEM to proceed with the accelerated program on July 11,

1967 (Defendant's Exhibit No. 183). Thereafter, Mr. Dalby of BETHLEHEM wrote to Mr. Dwyer on July 18, 1967, acknowledging the acceleration and confirming the fact that additional charges would be reduced to $96,271 for delays incurred to that point. This sum was paid in due course by the AUTHORITY, as well as other sums related to this first accelerated program.

From July of 1967 to the end of that year, BETHLEHEM and Perini were both engaged in working on the various piers, some of which had been made available to BETHLEHEM, and some of which were still under construction by Perini. By January of 1968, Perini had completed all substructure work and had removed its personnel from the project site.

The progress of the work up to January 1968 had not met the schedules contemplated in the first accelerated program authorized in July of 1967. As a result thereof, a meeting was held on January 29, 1968, between representatives of BETHLEHEM and PARSONS in order to discuss the present and prospective construction schedules.

At this meeting Mr. Elder presented certain sketches and proposals which would be designed to accomplish further acceleration of the BETHLEHEM steel erection work. These proposals were labeled Scheme A, Scheme B, Scheme C and Scheme D. Scheme B proposed working six 9-hour day shifts beginning February 1, 1968, and contemplated a completion of the work about August 14, 1968. The additional overtime costs for this program were estimated at $324,352. Scheme C proposed the beginning of six 9-hour days on February 1, 1968, and then the commencement of six 10-hour days beginning March 1, 1968, with a completion expectation of approximately August 2, 1968. The additional overtime charges estimated for Scheme C to be paid by the AUTHORITY were approximately $497,079.

As a result of a number of meetings between members of the AUTHORITY and representatives of PARSONS, it was ultimately decided to authorize BETHLEHEM to proceed with Scheme B on February 7, 1968, and thereafter, following further conferences with financial advisors, the AUTHORITY authorized a further acceleration under Scheme C to commence March 1, 1968, or as soon thereafter as possible.

It appears undisputed that BETHLEHEM did implement Scheme B and Scheme C in response to the instructions of the AUTHORITY and proceed to bill the AUTHORITY for the additional nonproductive overtime as it had billed the AUTHORITY for the various additional expenses incident to the initial acceleration program. At no time did BETHLEHEM ever promise under any of these accelerated programs to do more than exercise its best efforts to achieve the desired result.

In the course of erecting the steel cable and in performing other superstructure work, certain delays were encountered which made it impossible to complete the bridge during the summer of 1968, and in July of that year certain iron workers employed on the deck contract went on strike. This made an opening of the bridge during the summer of 1968 obviously impossible. Therefore, the AUTHORITY terminated the accelerated program about the 1st of August, 1968. Up to that point it had paid BETHLEHEM slightly less than $800,000 in additional contract charges. This was over and above the basic contract price of $18,945,541 for the construction of the steel superstructure of the main spans and approach spans of the bridge as set forth initially in Contract No. 3.

Thereafter, construction work continued on the bridge, without the benefit of acceleration, and the bridge was actually opened in June 1969.

On the basis of these facts, BETHLEHEM seeks further damages from the AUTHORITY for delays incurred both

prior to June 20, 1967, and thereafter, in the sum of $4,918,538, includng interest and cost of invested capital.

Certain threshold questions must be considered in determining the validity of the BETHLEHEM claim, which is based upon the breach of an implied warranty of availability of piers on the dates scheduled in the bid documents.

The Court must first look for guidance on this issue to the contract documents themselves. The contract does not contain any express promise or warranty that piers or work to be performed by other contractors would be available on any specific date. In the opinion of the Court, the schedules set forth in the bid documents are given by way of information as opposed to purporting to constitute a promise, guarantee or warranty.

Indeed, Article 105.07 of the Standard Specifications of the Rhode Island Department of Public Works, which were incorporated by reference in the BETHLEHEM contract, provides as follows:

> "Each contractor shall assume all liability, financial or otherwise, in connection with his contract and shall protect and save harmless the AUTHORITY from any and all damages or claims that may arise because of inconvenience, delay or loss experienced by him because of the presence and operations of other contractors working in the limits of the same project."

It would appear that the foregoing language was designed to insulate the AUTHORITY from damage claims made by one contractor as a result of delays in the performance by another contractor. This provision would certainly seem to cover the holding harmless of the AUTHORITY as a result of any delays occasioned by the failure of Perini to meet its schedule of completion of work. The presence of this article would also seem emphatically to negate any implied warranty on the part of the AUTHORITY that work to be accom-

plished by another contractor could or should result in claims against the AUTHORITY by BETHLEHEM.

It has been mentioned in a number of cases that a governmental authority is not liable to a contractor as a result of a delay by another contractor in providing the site of work in readiness by a particular date. *H. E. Crook* v. *United States*, 270 U.S. 4, 70 L. Ed. 438 (1926); *United States* v. *Rice*, 317 U.S. 61, 87 L. Ed. 53 (1942). To the same effect was *United States* v. *Foley*, 329 U.S. 64, 91 L. Ed. 44 (1946).

All of the foregoing cases were cited in the case of *Gilbane Building Co.* v. *United States*, 166 Ct. Cl. 347, 333 F.2d 867 (1964), wherein the contractor sought damages incurred by a delay in delivering a site at the Naval Supply Depot in Newport, Rhode Island, upon which the contractor had been awarded the job of building a transit shed. The site preparation necessitated a filling in of a portion of Narragansett Bay by another contractor. Gilbane's contract represented that the site would be ready for Gilbane on November 22, 1954. By virtue of major hurricanes and bad weather, as well as by certain change orders, the site was not ready for Gilbane until the late spring of 1955. In analyzing this claim, the Court took the position, citing *Crook* v. *United States*, *supra*; *United States* v. *Rice*, *supra*; and *United States* v. *Foley*, *supra*, that such liability would not exist for delay on the part of another contractor unless the contract so provided in specific language or unless the government as owner was directly and specifically responsible for such a delay.

The same general principles were enunciated in the case of *Endres Plumbing Corp.* v. *State*, 198 Misc. 546, 95 N.Y.S.2d 574 (1950) wherein the New York Court of Claims reviewed a large number of cases in this area and concluded that a governmental authority was not liable for delay on the part of another contractor, absent its own active interference with the work or its own active participation in the delay.

Certainly, Article 105.07 of the Standard Specifications negates any express warranty on the part of the AUTHOR-

ITY that it will take responsibility for the delay caused by another contractor to BETHLEHEM. Indeed, its plain and unambiguous meaning is specifically to the contrary.

An analysis of the testimony of the principal witnesses on the delay aspect of the case indicates that the AUTHORITY and PARSONS exercised every effort to promote as speedy accomplishment of the work to be performed by Perini as circumstances would permit. This included the use of overtime, appropriate equipment, and intensive efforts to make up for lost time caused by accident and foul weather conditions.

We now come to a portion of the case which BETHLEHEM has argued is an indication of active interference by the AUTHORITY, namely, the decision to enter upon the accelerated programs set forth in Construction Schedule 4 and ultimately in Schemes B and C which were superimposed upon Construction Schedule 4. This is argued by BETHLEHEM as the type of active interference which would cause the AUTHORITY to be directly responsible for additional cost incurred by delay. In this Court's opinion, BETHLEHEM totally misapprehended the nature and the genesis of the acceleration programs.

It is undisputed in the testimony that when it became apparent that pier construction delays had made it impossible for BETHLEHEM to finish its superstructure work on time, a series of conferences were conducted between representatives of the AUTHORITY and BETHLEHEM. These conferences have been referred to in detail in the summary of facts above. The determination to embark upon the accelerated program was not a unilateral directive issued by the AUTHORITY or by PARSONS. It was a mutual agreement to accept a proposal set forth in two letters submitted by BETHLEHEM and dated June 20, 1967 (Plaintiff's Exhibits No. 200 and 201). It is true that in these letters BETHLEHEM had made claim for additional expenses incurred by it

in the sum of $171,856 as a result of delays suffered up to that time. It is also true that in the same correspondence, BETHLEHEM indicated that its damage for delays would be reduced to $96,271 in the event that the accelerated program should be adopted at a total cost of $468,971.

At this point, the AUTHORITY might well have disputed BETHLEHEM'S claim for losses incurred by delay, a fact which has been referred to vigorously in argument on behalf of BETHLEHEM. In the Court's opinion the AUTHORITY approached the problem of overcoming delay not in an adversary fashion, but with the paramount practical motivation of opening the bridge as soon as possible. It realized that concessions must necessarily be made to BETHLEHEM if this acceleration were to be achieved.

It is also of the utmost significance to note that under BETHLEHEM'S claim of June 20 1967, all costs of delay absent acceleration would have been $171,856. Presumably acceleration had not beeen adopted, BETHLEHEM would have been entitled to extend its time for performance without becoming liable for the liquidated damages which the contract provided in the event of delay in performance. There is no doubt in the Court's mind that BETHLEHEM was entitled to such an extension as the Perini delays would have made necessary.

However, in adopting the acceleration proposal made by BETHLEHEM itself, the AUTHORITY was not depriving BETHLEHEM of any right of extension; it was substituting a program under which BETHLEHEM would not only receive extra monies for additional efforts expended, but would even receive an amount for past costs which may well have been otherwise subject to dispute.

Thus, in the opinion of the Court, the agreement which was reached on the basis of the exchange of correspondence beginning on July 11, 1967 by letter of the AUTHORITY and

culminating by the acknowledgement of Mr. Dalby on July 18, 1967, constituted an accord and satisfaction between the parties up to that point, and certainly did not constitute active interference by the AUTHORITY.

It is argued on behalf of BETHLEHEM that nothing in this exchange of correspondence precluded the assertion of further claims in the event that the acceleration program did not succeed.

This argument is set forth in Defendants' brief from pp. 291 to 294. However, this argument fails to take into account the provisions of Paragraph 105.17 of the Standard Specifications, which were a part of Contract No. 3. This paragraph provides as follows:

> "If, in any case, the Contractor deems that additional compensation is due him for work or material not clearly covered in the contract or not ordered by the Engineer as extra work, as defined herein, the Contractor shall notify the Engineer in writing of his intention to make claim for such additional compensation before he begins the work on which he bases the claim. If such notification is not given, and the Engineer is not afforded proper facilities by the Contractor for keeping strict account of actual cost as required, then the Contractor hereby agrees to waive any claim for such additional compensation."

The terms of that provision would have made it strikingly necessary for BETHLEHEM to have notified the AUTHORITY in June or July of 1967 of the horrendous results of the failure of its acceleration program to achieve its desired time schedules. Let us just consider for a moment what these results are now claimed to be.

Rather than a claim for $171,856, without acceleration, BETHLEHEM now presses a claim of $4,918,538 as set forth in Items "A" through "P" of its Exhibit No. 144, all of

which, save Item "B" (which amounts to $33,081), is based upon costs incurred as a result of delay. It is also noteworthy that the specifics of this claim were never presented to the engineer at any time and were only presented in the framework of the case in April of 1974 when Defendants' Exhibit 144 was introduced into evidence over the strenuous objection of the plaintiff.

It must also be remembered that as of June 20, 1967, more than half of the delay resulting from the Perini misfortunes had already been incurred. It has been established and is found by the Court as a fact that Perini was off the job entirely by January of 1968, less than six months subsequent to the new agreement on acceleration and prior to March of 1968 when Scheme C, at agreed additional cost to the AUTHORITY, was superimposed upon Construction Schedule 4.

The proposition that BETHLEHEM'S legitimate claim as a result of the failure of acceleration could have grown from the sum of $171,856 on June 20 of 1967 to more than four and one half million dollars by the end of the construction project as a result of the delay in delivery of six major piers (all of which were in fact delivered before January 1968) stretches the credulity of this Court well beyond its breaking point.

Defendants' Exhibit No. 144 was developed through the testimony of two witnesses. It represents the difference between Mr. Assetto's estimates as to what the job should have cost BETHLEHEM, and the testimony of Mr. Elder, as to what the job actually did cost BETHLEHEM. As previously indicated, the details and the backup of Defendants' Exhibit No. 144 were not presented to the engineers or the AUTHORITY until it was introduced into court in April, 1974, approximately five years after the structural steel construction work by BETHLEHEM had been completed.

This Court is consequently constrained to reject the claims set forth in Defendants' Exhibit No. 144 in their entirety.

However, in dealing with Defendants' Exhibit No. 144, it is necessary for the Court to consider Item "B" separately. Item "B," which amounts to $33,081, is not based upon the delay of the date of delivery of the major piers, but is a claim for extra work based upon the alleged deletion of certain concrete work from Contract No. 3 as revised. There is no question that the concrete work was deleted prior to the second call for bids. It is, however, the testimony of Mr. Mandel that the requirement of performance of bush hammering by the steel contractor remained as a part of the plans. Obviously, this state of affairs resulted in an ambiguity in respect to the contract. This ambiguity resulted in an exchange of correspondence between Mr. Welch of BETHLEHEM and Mr. Mandel. These letters have been introduced as Plaintiff's Exhibits No. 287 and 288. After this exchange of correspondence, Mr. Pitchford proceeded to request approval of a subcontractor from PARSONS, and the firm of Bacon & McLeish was approved for this purpose by PARSONS in Plaintiff's Exhibit No. 285. Indeed, as late as December 18, 1969, a claim for extra work by Bacon & McLeish was submitted through Mr. Kinney to Mr. Mandel and was subsequently paid by the AUTHORITY in the amount of $6,178. This payment is recognized and set forth as a credit in BETHLEHEM'S outline of Item "B" in Defendants' Exhibit No. 144.

Here, as mentioned above, was a clear situation in which the provisions of Paragraph 105.17 must of necessity be invoked. If the bush hammering work was to be regarded as an extra under the contract, a clear and unequivocal claim for such an extra should have been made in May of 1966 when the ambiguity was considered between Mr. Welch and Mr. Mandel. No such claim was made then, and no such claim can properly be considered now by this Court.

Therefore, this Court finds as a matter of fact and concludes as a matter of law that BETHLEHEM has failed to sustain its burden of proving that it is entitled to recompense for any alleged cost of delay as set forth in Items "A" through "P" of Defendants' Exhibit No. 144, other than those which were paid to it by the AUTHORITY under the accord and satisfaction reached between the parties in respect to Construction Schedule 4 as expanded by superimposing Scheme C thereon. The Court finds specifically as a matter of fact that the AUTHORITY and PARSONS did not warrant the delivery of piers at any particular time, that the AUTHORITY and PARSONS did not actively interfere with the work of the project, but did everything within their power to promote, implement and accelerate such progress throughout the life of the entire project.

This Court further finds as a matter of fact and concludes as a matter of law that BETHLEHEM is not entitled to receive compensation for its claim under Item "B" of Defendants' Exhibit No. 144 as a result of its failure to give timely notice that it considered such work to be extra work under the contract as Paragraph 105.17 of the Standard Specifications clearly required.

For the reasons stated, BETHLEHEM is not entitled to recover under the third count of its counterclaim against the AUTHORITY.

In the foregoing analysis, the Court has not dealt with the extensive testimony of Mr. Zecher in regard to the individual items set forth in Defendants' Exhibit No. 144. This testimony merely constituted hypothetical rebuttal to those items in the event that the Court should have rejected the other defenses of the AUTHORITY regarding the lack of warranty of delivery of piers, accord and satisfaction, and the requirement of timely notice of the claims. Since the Court has rejected BETHLEHEM'S claims on the foregoing

grounds, no consideration or analysis of Mr. Zecher's hypothetical rebuttal testimony is required to be given in this decision.

The Court has already determined earlier in this decision that the AUTHORITY is entitled to recover the sum of $5,064,407.63 for the cost of remedial painting made necessary by the improper application and surface preparation by BETHLEHEM of the paint system on the Newport Bridge. The Court has also determined that the defendant BETHLEHEM is entitled to a credit under the first count of its counterclaim of $804,996.55, the balance of the original contract price which has not yet been paid. Crediting this amount would give rise to a net liability on the part of BETHLEHEM to the AUTHORITY in the sum of $4,259,411.08. To this sum, it is contended by the AUTHORITY that interest should be added.

It seems to be conceded by both of the parties that interest in an action of breach of contract should be allowed even in respect to claims which are unliquidated where it would seem equitable and just in order to make the injured party whole. This general principle is set forth in *Corning Glass Works* v. *Seaboard Surety Co.*, 112 R.I. 241, 308 A.2d 813 (1973). The Court stated at p. 250 of its opinion (112 R.I.) the contrast between the law respecting interest in tort actions and contract actions:

> "The rule, however, is different in suits for a contract. Over a half-century ago, the court in *Pearson* v. *Ryan*, 42 R.I. 83, 105 A. 513 (1919), adopted the view that interest will be allowed in those instances when it seemed equitable to do so even where the person sought to be charged did not know the amount of the debt or damages, and when the time of its being due was fixed only by the demand for payment. In fact, in *Pearson* reference was made to Sedgwick, Damages § 315 (8th

ed. 1891), where the author observed, 'Where interest is refused in actions of contract on the ground that the claim is unliquidated, it is in fact usually allowed from the date of the writ.' *Id.* at 87, 105 A. at 514. Later on, in *Providence Transit Concrete Corp.* v. *New England Concrete Corp.*, 65 R.I. 430, 14 A.2d 807 (1940), interest from the inception of the suit to the date of judgment was approved."

Similar principles have been enunciated in *Russolino* v. *Rotelli & Sons, Inc.*, 85 R.I. 160, 128 A.2d 337 (1957). It is further suggested in 5 Corbin on Contracts, §§ 1048-1049 (1964):

"In many jurisdictions interest is recoverable as damages, even though the amount payable has not been definitely liquidated by the parties and is not capable of being so liquidated by mere mathematical computation, even with the aid of market prices. In every case the plaintiff has suffered injury that ought to have been made good at once. It if had been made good, he would have had the use of all the money so paid him. These courts believe, therefore, that the principle of full compensation requires that he should receive the value of this use in the form of interest. Interest has been allowed, therefore, in cases where the defendant's breach . . . consisted in defects or delay in construction work . . . In contracts for work and labor or for the construction of buildings, interest has not infrequently been allowed . . . It is believed that interest should be allowed as part of the damages in all cases in which full performance by the plaintiff would have resulted in the creation of a liquidated debt in the defendant, and such full performance has been prevented by the repudiation or default of the defendant."

Applying these principles to the facts of the case, it would seem equitable to allow to the AUTHORITY interest at the usual legal rate of six per cent on amounts actually paid by it to Oliver B. Cannon for remedial painting after the exhaustion of the credit to BETHLEHEM of $804,996.55, to which it was entitled. These payments have been made on dates which are apparently undisputed, beginning May 24, 1971 and ending on February 1, 1974, during the pendency of this action. The payments constitute 22 in number and exhaust the credit due to BETHLEHEM as of November 1, 1971, when a payment of $124,383.96 was made to Cannon and a credit of only $68,760.31 remained to BETHLEHEM. As an appendix to this decision the dates and amounts of the payments, as well as the credits due to BETHLEHEM and the interest computations, are set forth, as of September 15, 1975. This would give rise to a total charge for interest, as of that date, in the amount of $239,475.35. Adding said amount to the net sum due to the AUTHORITY, judgment is hereby rendered in favor of the AUTHORITY for the sum of $4,498,886.43, together with interest which shall have accrued down to the date of the filing of this decision and the entry of judgment pursuant thereto, plus costs, as against BETHLEHEM and its surety, INA.

Computation of Interest on Sums Expended by Plaintiff for Remedial Painting
as of September 15, 1975

Payment to Cannon and Date	Amount of Payment	Credit to Bethlehem on Count I of Counterclaim	Amount of Interest as of Date of Computation at 6%
#1. May 24, 1971	70,945.63	70,945.63	—
#2. June 24, 1971	110,249.57	110,249.57	—
#3. July 29, 1971	161,314.02	161,314.02	—
#4. Aug. 30, 1971	176,941.53	176,941.53	—
#5. Sept. 20, 1971	216,785.49	216,785.49	—
#6. Nov. 1, 1971	124,382.96	68,760.31	12,932.50
#7. Dec. 5, 1971	55,763.32	—	12,732.44
#8. March 6, 1972	33,282.07	—	7,044.48
#9. April 10, 1972	15,925.00	—	3,277.84
#10. June 15, 1972	31,022.75	—	6,049.44
#11. July 10, 1972	104,206.60	—	19,885.75
#12. July 28, 1972	112,085.50	—	21,072.07

Payment to Cannon and Date	Amount of Payment	Credit to Bethlehem on Count I of Counterclaim	Amount of Interest as of Date of Computation at 6%
#13. Aug. 21, 1972	174,979.88	—	32,224.29
#14. Oct. 13, 1972	148,921.23	—	26,110.36
#15. Nov. 9, 1972	43,406.57	—	7,442.52
#16. June 4, 1973	28,797.35	—	3,940.34
#17. June 29, 1973	121,419.61	—	16,107.53
#18. July 24, 1973	120,331.36	—	15,481.83
* #19. Sept. 15, 1973	135,475.66	—	16,257.08
#20. Oct. 12, 1973	154,369.43	—	17,829.67
#21. Nov. 16, 1973	126,809.41	—	13,949.04
#22. Feb. 1, 1974	74,954.69	—	7,158.17
	2,342,370.63	804,996.55	239,475.35

* no requisition

IV (B)

Revised Judgment of Superior Court
Entered January 30, 1976.

State of Rhode Island
Newport, Sc.

Superior Court

Rhode Island Turnpike and Bridge Authority	)	
Plaintiff	)	
-vs-	)	C. A. File
Bethlehem Steel Corporation and	)	No. 70-237
Insurance Company of North America	)	
Defendants	)	
-vs-	)	
Walter S. Douglas, et al	)	
Counterclaim Defendants	)	

Revised Judgment.

The above-entitled case came on for hearing before this Court on January 16, 1974, and after 89 days of trial, concluding on December 18, 1974, upon consideration of nearly 2,000 individual exhibits introduced by the parties to this litigation, after consideration of memoranda of fact and law submitted by the parties, after hearing final argument on July 1, 2 and 3, 1975, and after receipt of supplemental memoranda from the parties in July of 1975 on the subject of interest, this Court does hereby render the following judgment:

1. The Authority is entitled to recover on its principal complaint the sum of $5,064,407.63 for remedial painting costs incurred and to be incurred as a result of faulty preparation of the surface of the steel and faulty application thereto of paint coatings on the various structural members of the Newport Bridge as erected by defendant Bethlehem.

2. Defendant Bethlehem is entitled to recover on the first count of its counterclaim the balance of the contract price in the sum of $804,996.55, which should be credited against the

sum to which the Authority would be entitled under Paragraph 1 hereof.

3. Defendant Bethlehem is entitled to recover nothing under Count II of its counterclaim and said count of the counterclaim is denied and dismissed as against the Authority and Parsons.

4. Defendant Bethlehem is entitled to recover nothing under Count III of its counterclaim and said count of the counterclaim is denied and dismissed as against the Authority.

5. The Authority is entitled to recover interest at the rate of six per cent (6%) upon amounts paid to Oliver B. Cannon & Sons, Inc. for remedial painting over and above the credit due to defendant Bethlehem on Count I of its counterclaim. Under this computation, the plaintiff Authority is entitled to the sum of $283,569.47 in interest to be added to the principal sum set forth in Paragraph I of this Judgment as of December 31, 1975.

5(A). The Authority is entitled to recover interest at the rate of six percent (6%) upon amounts paid to Parsons, Brinckerhoff, Quade & Douglas for engineering supervision of remedial painting. Under this computation the plaintiff Authority is entitled to the sum of $28,348.84 in interest to be added to the principal sum set forth in Paragraph 1 of this Judgment as of December 31, 1975.

6. Judgment is hereby rendered in favor of the plaintiff Authority against defendants Bethlehem and INA in the total sum of $4,571,329.39, plus costs.

7. Judgment is rendered in favor of counterclaim defendant Parsons for its costs.

8. The findings of fact and the conclusions of law which have been made by this Court are set forth in a written decision which is appended hereto and made a part hereof, and will therefore not be repeated in this Judgment document.

By Order,

/s/ Louis O. Wright
Deputy Clerk

ENTER:

/s/ Weisberger, P.J.
Weisberger, P.J.

January 30, 1976

V (A)

Notice of Appeal to the Supreme Court of the United States Filed June 24, 1982.

The Supreme Court of the State of Rhode Island

Rhode Island Turnpike and Bridge Authority	)	
-v.-	)	Case No. 81-480-A
Bethlehem Steel Corporation and Insurance Company of North America	)	

Notice of Appeal to the Supreme Court of the United States

Notice is hereby given that Bethlehem Steel Corporation and Insurance Company of North America, the appellants above-named, hereby appeal to the Supreme Court of the United States from that portion of the final decision of the Supreme Court of Rhode Island denying the appeal of said appellants, issued in this action on June 4, 1982.

John V. Kean, Esq.
David L. Mayer, Esq.
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Providence, Rhode Island 02903

Leslie A. Hynes, Esq.
HYNES, DIAMOND & REIDY
26 Broadway
New York, New York 10004

Attorneys for Appellants

June 24, 1982.

Certificate of Service

I hereby certify that on the 24th day of June, 1982, I mailed a copy of the within Notice of Appeal to Edward T. Hogan, Esq., HOGAN & HOGAN, 101 Waterman Avenue, East Providence, Rhode Island, 02914 and to Brian Bardorf, Esq., SHEFFIELD & HARVEY, Four Meeting Street, Newport, Rhode Island 02840, co-counsel for appellee Rhode Island Turnpike and Bridge Authority.

V (B)

Supplemental Notice of Appeal to the Supreme Court of the United States Filed July 23, 1982.

The Supreme Court of the State of Rhode Island

Rhode Island Turnpike and Bridge Authority	)	
-v.-	)	Case No. 81-480-A
Bethlehem Steel Corporation and Insurance Company of North America	)	

Supplemental Notice of Appeal to the Supreme Court of the United States

Notice is hereby given that Bethlehem Steel Corporation and Insurance Company of North America, the appellants above-named, pursuant to 28 U.S.C. § 1257(2), hereby appeal to the Supreme Court of the United States from that portion of the final decision of the Supreme Court of Rhode Island denying the appeal of said appellants, issued in this action on June 4, 1982.

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Attorneys for Appellants

July 23, 1982.

Certificate of Service

I hereby certify that on the 23rd day of July, 1982, I mailed a true copy of the within Supplemental Notice of Appeal to Edward T. Hogan, Esq., HOGAN & HOGAN, 101 Waterman Avenue, East Providence, Rhode Island, 02914 and to Brian Bardorf, Esq., SHEFFIELD & HARVEY, Four Meeting Street, Newport, Rhode Island 02840, co-counsel for appellee Rhode Island Turnpike and Bridge Authority.

VI (A)

Chapter 54, 1981 Public Laws of Rhode Island.

"AN ACT Relating to Interest rates on Judgments

It is enacted by the General Assembly as follows:

Section 1. Sections 9-21-8 and 9-21-10 of the General Laws in Chapter 9-21 entitled "Judgments, Orders and Decrees" are hereby amended to read as follows:

9-21-8. INTEREST ON JUDGMENT.—Every judgment for money shall draw interest *at the rate of twelve percent (12%) per annum* to the time of its discharge.

9-21-10. INTEREST IN CIVIL ACTIONS.—In any civil action in which a verdict is rendered or a decision made for pecuniary damages, there shall be added by the clerk of the court to the amount of damages, interest at the rate of *twelve* per cent (12%) per annum thereon from the date the cause of action accrued which shall be included in the judgment entered therein. This section shall not apply until entry of judgment or to any (contractual) obligation where interest is already provided or as to any condemnation action.

6-26-1. LEGAL RATE OF INTEREST.—Interest in the rendition of judgments, and in all business transactions where interest is secured or paid, shall be computed at the rate of *twelve* dollars ($12.00) on one hundred dollars ($100) for one (1) year, unless a different rate is expressly stipulated.

Sec. 3. This act shall take effect upon its passage and shall be given retroactive as well as prospective effect and shall apply to all cases pending upon the effective date of this act.

VI (B)

Rhode Island General Laws § 9-21-10
[prior to amendment effective May 8, 1981].

9-21-10. Interest in civil action.—In any civil action in which a verdict is rendered or a decision made for pecuniary damages, there shall be added by the clerk of the court to the amount of damages, interest at the rate of eight per cent (8%) per annum thereon from the date the cause of action accrued which shall be included in the judgment entered therein. This section shall not apply until entry of judgment or to any contractual obligation where interest is already provided or as to any condemnation action.